STATE DOCUMENTS

An Engineering Study
of Road and Street Needs

MOVING AHEAD ON MONTANA'S HIGHWAYS

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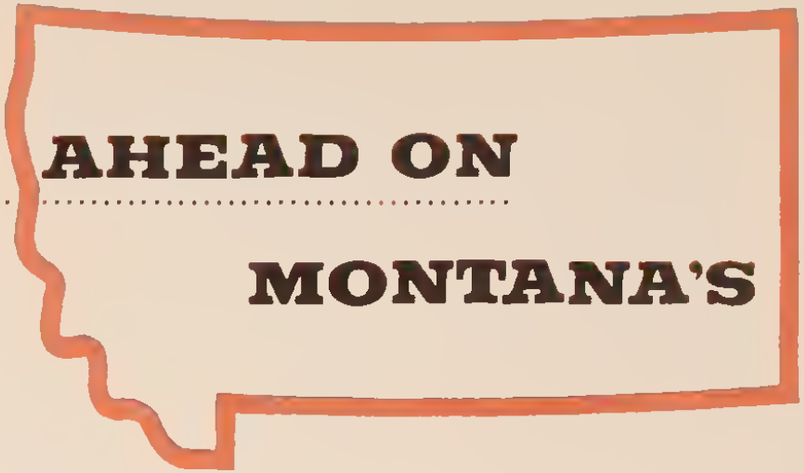
MOVING AHEAD ON MONTANA'S HIGHWAYS



An Engineering Study
of Road and Street Needs

A Report to the MONTANA FACT FINDING COMMITTEE
on HIGHWAYS, STREETS, and BRIDGES

Prepared by the AUTOMOTIVE SAFETY FOUNDATION

Cooperating MONTANA STATE HIGHWAY COMMISSION
and the U. S. DEPARTMENT OF COMMERCE, BUREAU OF PUBLIC ROADS

November, 1956

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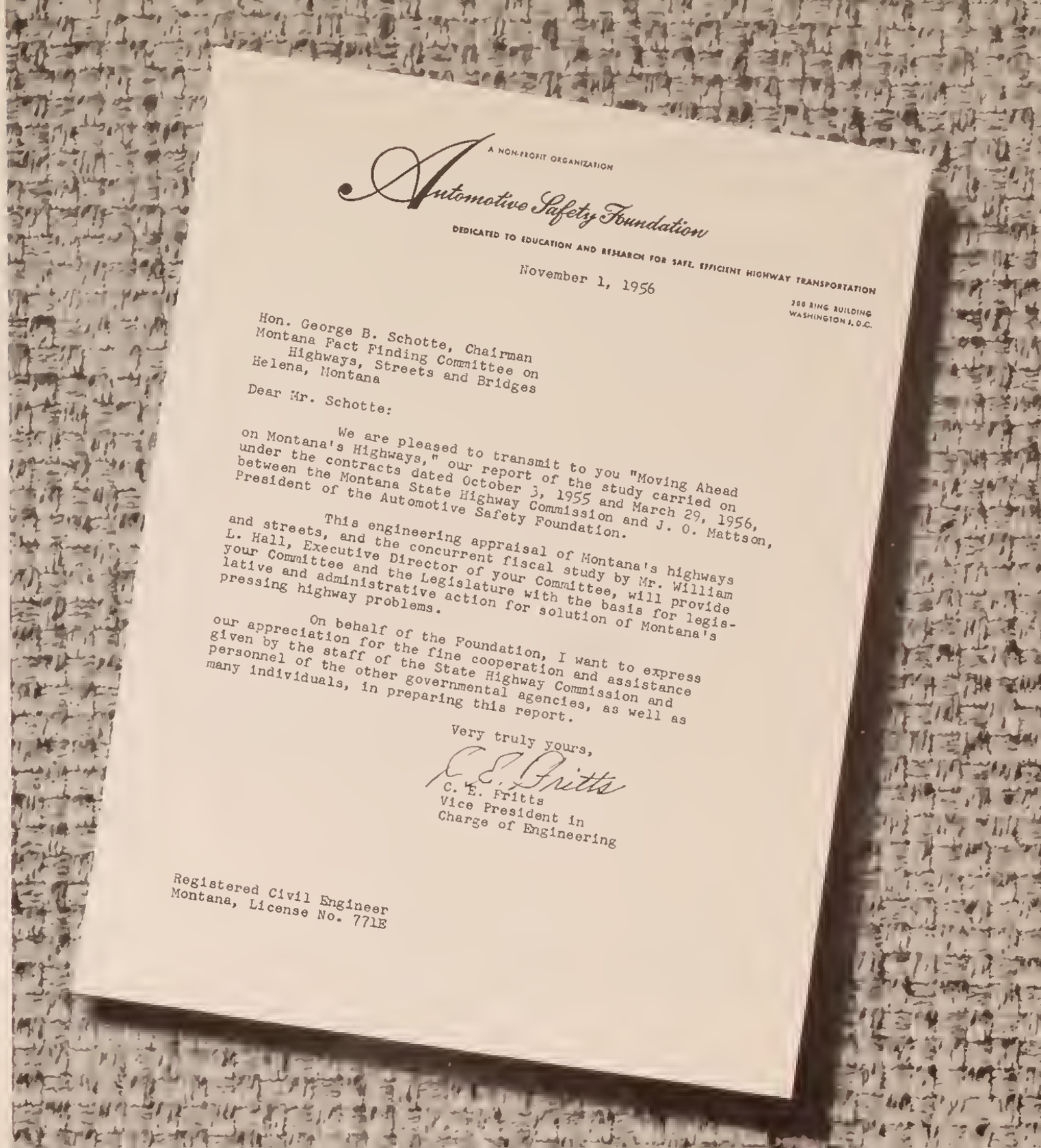

A NON-PROFIT ORGANIZATION

Automotive Safety Foundation

DEDICATED TO EDUCATION AND RESEARCH FOR SAFE, EFFICIENT HIGHWAY TRANSPORTATION

November 1, 1956

200 RING BUILDING
WASHINGTON 6, D.C.

Hon. George B. Schotte, Chairman
Montana Fact Finding Committee on
Highways, Streets and Bridges
Helena, Montana

Dear Mr. Schotte:

We are pleased to transmit to you "Moving Ahead on Montana's Highways," our report of the study carried on under the contracts dated October 3, 1955 and March 29, 1956, between the Montana State Highway Commission and J. O. Mattson, President of the Automotive Safety Foundation.

This engineering appraisal of Montana's highways and streets, and the concurrent fiscal study by Mr. William L. Hall, Executive Director of your Committee, will provide your Committee and the Legislature with the basis for legislative and administrative action for solution of Montana's pressing highway problems.

On behalf of the Foundation, I want to express our appreciation for the fine cooperation and assistance given by the staff of the State Highway Commission and personnel of the other governmental agencies, as well as many individuals, in preparing this report.

Very truly yours,

C. E. Fritts

C. E. Fritts
Vice President in
Charge of Engineering

Registered Civil Engineer
Montana, License No. 771E

Contents

SUMMARY		9
CHAPTER 1	*A Round-up of Background Facts*	11
CHAPTER 2	*Classification*	23
CHAPTER 3	*Management*	35
CHAPTER 4	*State Highways*	45
CHAPTER 5	*County Roads*	59
CHAPTER 6	*Municipal Streets*	67
CHAPTER 7	*Evaluation*	75
APPENDIX		82

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TERRAIN IS A MAJOR FACTOR IN MONTANA HIGHWAY DEVELOPMENT

In the mountoins, rock formotions ond rough topogrophy moke rood construction difficult ond expensive. In the vost ploins oreo, sev-erol lengthy, wide rivers ond countless smolter streoms require costly bridge construction.

Montono's diversity of terroin olso is reflected in its economy. Minerol ond timber resources, power production ond tourist trode choroc-terize the mountainous western third of the stote; ogriculture, grozing ond petroleum pro-duction the eastern two-thirds.

The problem now is thot of modernizing pri-mory highwoys to keep obreost of increasing troffic ond of improving principol locol roods which top much of the stote's resources.

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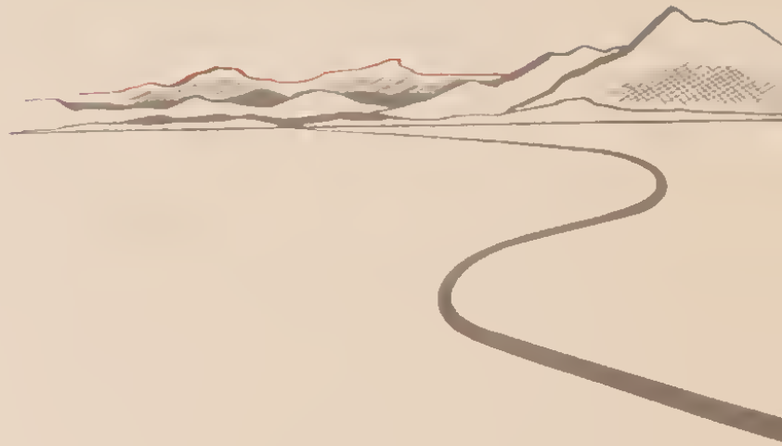
Foreword



MONTANA'S HIGHWAY PROBLEM is the result of many things. Montana is a state of "wide-open" spaces with great distances between communities. In area it ranks third largest in the Union, measuring some 580 miles east and west and 315 miles north and south. It is a state with extreme topographic differences. Altitudes range from a high of 12,850 feet at Granite Peak to a low of 1,820 feet where the Kootenai River crosses the western boundary.

Although third in area, Montana is forty-second in population among the states. Population density is only about four persons per square mile as compared with the national average of 51.

The state's huge highway plant consists of over 72,500 miles of roads and streets administered by 180 separate independent highway agencies, yet all are a part of a single transportation network. The large mileages involved, and the many agencies with jurisdiction over them, pose major problems of intergovernmental relationships and planning, and of reasonable and balanced programming. The sparsity of the state's population presents difficulties in raising revenues sufficient to support the far-flung road and street network.

Several other factors contribute to the complexity of Montana's highway problem. Extremes in climatic conditions increase construction costs. Reduced load limits during the spring add to the costs of motor truck transportation. Increasing public demands require that great mileages of roads be kept open for year-round travel. Costs of snow plowing and ice control on state highways have more than doubled in the last eight years.

In recent years several interim highway committees, appointed by the governor, have studied the state's highway problems. These committees have done a commendable job and a number of their recommendations were enacted into law. A stumbling block to the interim committees and to the legislators has been a lack of knowledge of the actual and relative needs on each class of roads and streets. Such information is basic for development of an adequate and equitable fiscal plan.

A comprehensive study of the state's total highway problem was authorized by Chapter 99, Laws of Montana, 1955. This legislation authorized the governor to appoint a Fact Finding Committee on Highways, Streets, and Bridges, with one member from each of the 12 highway financial districts. This Committee was instructed to study and review highway and street laws, policies and needs, and to prepare a finance plan to provide for an adequate highway program, including county roads and city streets. The legislation also provided for a Council for Highway Research, composed of members appointed by the governor to represent organizations as shown on page 2, to serve in an advisory capacity to the committee.

The Fact Finding Committee, acting through the Montana State Highway Commission, entered into an agreement on August 31, 1955, with the Automotive Safety Foundation of Washington, D. C., to supervise and direct an engineering study of highway and street needs and improvement costs. The Foundation is a non-profit organization dedicated to education and research for safe, efficient highway transportation.

Concurrently, the Fact Finding Committee, under the supervision of its Executive Director, has conducted an independent but related study of highway finances. The costs of both the engineering and finance studies have been jointly financed by the U. S. Bureau of Public Roads and the State Highway Commission as a Federal-aid Highway Planning Survey Project.

Although both studies have been conducted independently and the results are being published in separate reports, the two technical staffs have coordinated their work throughout. In arriving at a workable and equitable solution to the state's total road and street problem it will be necessary to consider the results of both the engineering and fiscal studies.

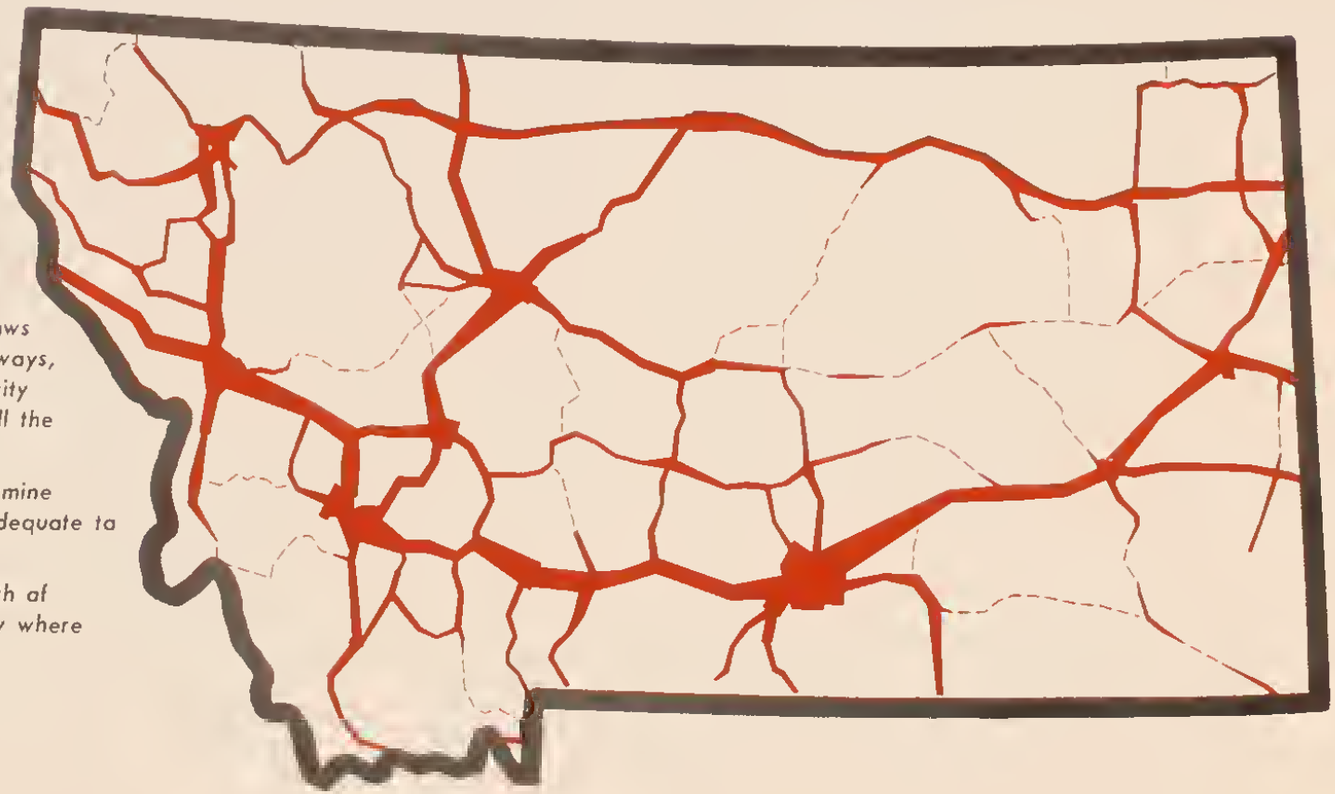
THE ENGINEERING STUDY ORGANIZATION

The engineering study was made under the supervision of the engineering staff of the Foundation's Highways Division by personnel of the State Highway Department, the counties and the cities.

To take full advantage of the knowledge of engineers and officials experienced in Montana road and street problems, four advisory committees composed of state, county and municipal engineers and officials were organized early in the study. Members of these committees were selected for their training, knowledge and experience in their particular fields of work. With the advice and counsel of these committees, procedures and instructions were prepared covering all phases of the engineering appraisal process. These procedures and instructions made possible a high degree of uniformity in reporting existing conditions and determining needed improvements.

Field work of the appraisal was performed by state, county and municipal engineers. In many instances, State Highway Department personnel assisted in the field work on county roads and city streets because of the lack of engineering personnel in local agencies. The engineering staff of the Foundation was responsible for methods of analysis of the field reports, review of interpretations, conclusions, recommendations and the contents of this report.

The engineering staff of the Foundation expresses its sincere appreciation to the several hundred state, county and municipal engineers and officials who actively participated in the study and to the members of the four advisory committees who gave generously of their time and invaluable advice and guidance.



This traffic flow map of the State Highway System shows the major streams of rural traffic in Montana. These highways, together with the thousands of miles of county roads and city streets, open the advantages of motor transportation to all the people of the state.

The purpose of the engineering appraisal was to determine the cost of making and keeping these roads and streets adequate to serve this vital function.

Relative volumes of daily traffic are indicated by width of band except on routes with less than 200 vehicles per day where dashed lines are used.

Summary

MONTANA faces a formidable highway problem.

Today, in spite of more than 40 years' effort by state and local governments, grave deficiencies handicap traffic on every class of public road and street. On State Highways, which carry about 70 percent of total state travel, no less than two-thirds of the mileage needs improvement within five years. One-third of the principal county roads and one-quarter of the major street mileage are presently inadequate. Development on many local roads and streets is below acceptable levels.

Without positive remedial action, these conditions will grow worse. Between now and 1976, gradual deterioration and a predicted 80 percent traffic increase will make it necessary to reconstruct or improve practically every mile of all these systems.

The Task

To provide adequate highway service, it will be necessary to clear away the backlog of existing deficiencies, to correct future deficiencies as they accrue, and to maintain and manage the several systems while this work is in progress. Completion of the entire rehabilitation job over a 20-year period will cost about $1.6 billion.

This engineering report appraises the extent of the state's highway needs and presents alternative programs framed to fit whatever revenue schedule may be recommended by the finance study and approved by legislative action. To provide for efficient operation, the report proposes logical grouping of the roads and streets, clear-cut assignment of highway responsibilities, and certain measures for improving highway administration.

Classification and Systems

About 7,000 miles of Montana's total mileage are special interest roads under Federal control and are not involved in this study. The remaining 65,500 miles, now loosely assigned to state or local jurisdiction, were classified into the following proposed systems according to their predominant service to traffic of statewide, community, or local interest:

The **Primary System** consists of 5,930 miles of rural highways and 167 miles of municipal streets. Practically all these routes are Federal aid Primary highways; 1,215 miles are on the vitally important National System of Interstate and Defense Highways. The proposed Primary System represents only 8 percent of all rural road mileage, but serves 77 percent of all rural travel. City extensions will carry 40 percent of total travel on municipal streets.

The legislature should authorize a State Highway System, limited to 6,250 miles, to consist initially of these Primary routes. It should give the State Highway Commission complete responsibility for the entire system, rural and urban.

The **Secondary System** consists of 12,100 miles of rural highways essential for countywide and intercounty travel. About 4,000 miles are now Federal-aid Secondary roads and eventually the rest will probably be so designated.

The legislature should authorize a Secondary Road System, limited to 12,500 miles, and an adequate plan for financing it. The roads should be selected initially by the counties on the principles adopted in this study with review and approval by the State Highway Commission. Complete management responsibility for these county interest roads should be transferred to the county boards as rapidly as these agencies qualify for such duties; until then, the state should retain responsibility for development.

Should the legislature decide that the service of Secondary roads warrants state aid, it could be made subject to such provisions as govern Federal aid to the states.

Local Rural Roads are the remaining 46,200 miles of land access routes; they include about 14,000 miles of infrequently used trails. They represent 66 percent of total rural road mileage, but carry only 7 percent of all rural travel. The counties should continue their responsibility for them.

The **Arterial Street System** consists of 209 miles of principal city thoroughfares which serve the major movements of city traffic. Management responsibility should be with the municipalities. Regardless of whether it is decided these streets should have state aid, the municipalities should be required to establish arterial street systems integrated with the urban routes of State Highways.

Local Streets are the 1,275 miles of access streets not classified as Primary route extensions or Arterial streets. The municipalities should continue to be responsible for them.

Management

The program proposed by this report demands improved management and a more rational statutory basis. Much of Montana's highway law was enacted long ago and does not apply to present conditions; the whole body of highway statutes should be reviewed and revised.

In the **State Highway Department** functions and responsibilities are too concentrated in the headquarters office and especially in the office of the State Highway Engineer. The latter should have a Deputy Highway Engineer and a Business Manager to share his administrative duties and give him sufficient time for over-all control and

more long range planning. Construction programs for at least five years in advance should be prepared with annual reviews to keep them current with conditions. In the field, the present 22 construction and maintenance divisions should be merged into six or eight divisions each under a Division Engineer responsible for all field activities in his division.

Boards of County Commissioners should be limited to formulation of county road policies and to broad administrative decisions. Each county should employ a full-time registered engineer or qualified road superintendent to plan and manage actual county road operations. He should be appointed by the County Board with approval of the State Highway Commission.

In **Municipalities** street management responsibilities should be centered in one office. In the larger cities technical management functions should be performed under a qualified city engineer. The smaller places could arrange with counties for technical assistance from the county road engineer.

Integration of Activities of state, county and municipal agencies concerned with the highway program, is important. The State Highway Commission is the logical coordinating agency. It should establish a new State Aid Division to perform these duties and to supervise operations under any policy of state aid to local units enacted by the legislature.

Highway Needs and Costs

All appraisals were based on the classified systems proposed in this report. Deficiencies were determined by reasonable criteria; no road now giving tolerable service was listed as deficient.

The 20-year construction, maintenance and administration costs for each system are as follows:

Systems	*Cost (In Millions)*
State Highway, including Interstate	$ 882
Secondary Road	322
Arterial Street	31
Total	$1,235
Local Roads	$ 268
Local Streets	77
Total	$ 345
TOTAL ALL ROADS AND STREETS	$1,580

Alternative Programs

To gear the work contemplated by this report with whatever fiscal plan may be found feasible, alternative programs were set up for each major system. These programs provide three different time periods for catching up on the existing and accruing backlog of deficiencies. However, programs for the Interstate System call for a 13-year catch-up and completion period to conform with the Federal-aid Highway Act of 1956.

Annual expenditures required by the alternative programs for the major systems, including the Interstate System, are as follows:

Ten-year Catch-up Program — $87.8 million per year for the first 10 years, $49.6 million the next three years, and $29.8 million the last seven years.

Fifteen-year Catch-up Program — $76.6 million per year for the first 13 years, $56.8 million the next two years, and $25.2 million the last five years.

Twenty-year Catch-up Program — $68.7 million per year the first 13 years and $48.9 million the last seven years.

The longer the catch-up period, the smaller are the annual costs; however, the backlog of deficiencies would go longer uncorrected. Under these circumstances, of course, it would take longer to gain the benefits which result from improved and adequate roads. The total 20-year costs for the major road and street systems are the same for each of the three alternative programs.

It is proposed that local roads and streets be completed during a 20-year period. The time and standards of improvement will vary among local units depending on the will to do the job and the ability to pay for it. The full program for these local roadways would cost $17.3 million per year throughout the 20-year period.

Conclusion

While the task of improving Montana's highways and streets to efficient standards is formidable, it is far from impossible. This can be seen clearly when the cost of highway rehabilitation is presented in terms of annual requirements as has been done in the alternative programs.

At the current rate, estimated revenues for Montana's road and street purposes from all sources for next year exceed $60 million. Increasing travel will produce an average of $9 million additional revenues per year during the next 20 years. Also, it is reasonable to assume continuation of Federal-aid funds at least at the higher levels now authorized for the 1959 fiscal year.

The separate concurrent fiscal study will evaluate the amount of future revenue from each source, determine the need for tax revision and the proper distribution of revenue necessary to accomplish the long range needs on each road and street system.

This engineering study, coupled with the fiscal report, gives Montana a sound basis for accomplishments which will produce great benefits for the people of the state.

Chapter I

a round-up of background facts

NOT UNTIL the discovery of gold in the early 1860's was serious attention given to the need for roads in Montana. Prior to that time, roads and trails had been crudely developed by pioneer settlers of the pre-territorial days and immigrants from the east to the Pacific Coast.

The influx of settlers which accompanied the discovery of gold created a strong demand for adequate roads to connect the mining settlements with the river ports of the Missouri and with the settled areas of the Midwest and West.

Part of the need was met by the construction of military roads under Federal jurisdiction. One of the first was the Mullan Road from the head of navigation on the Missouri River at Fort Benton westward to Walla Walla, Washington. Work on this road was started in 1859 and completed in 1863 at a cost of $230,000 for its 624-mile length. The Bozeman Road from Fort Laramie to Virginia City was authorized by Congress in 1865 as a post road to serve mining camps. In addition to these and other military roads, a number of toll roads, ferries and bridges were constructed and operated as private enterprises during the boom days of the early mining period.

Montana was granted separate territorial status in 1864. With the continued influx of population came increasing demands for a public road system. The Territorial Legislature in 1869 placed responsibility for providing and maintaining public roads in the hands of the Boards of County Commissioners. From 1869 to 1913, rural roads were the sole responsibility of the counties. This was a period when the state was growing rapidly. The Federal census of 1870 lists Montana's population as 20,595. The population increased steadily, passing 300,000 between 1900 and 1910. The coming of the railroads and opening of additional lands to homesteading contributed to this rapid increase in population.

The constantly increasing population generated demand for more and better roads to serve farms and ranches and to connect them with shipping points on the railroads. Many of the counties adopted bond issues in an attempt to meet the problem. Each county acted individually. There was little coordination of action between counties in development of roads for inter-county travel between principal cities.

The Motor Vehicle Era

A law passed in 1905 regulating the speed of motor vehicles was the state's first official recognition of the dawn of motor vehicle transportation. A motor vehicle licensing law was passed in 1913 which provided for annual registration fees of $2.00 per vehicle.

Legislation in 1913 created a State Highway Commission of three members. Initial activities of the Commission were limited to technical as-

sistance to counties and some use of convict labor for road construction. Counties continued the construction and maintenance of all roads within their boundaries.

The first state road map was prepared and published by the State Highway Commission in 1914.

Federal Highway Aid

A development which was to have a major effect on highway construction was the passage of the Federal-aid Road Act in 1916. This Act provided Federal funds for post road construction and required matching by state or local funds. Nearly all Federal-aid funds expended in Montana up to 1922 were matched by the counties. Motor vehicle registration fees constituted the only source of income for the State Highway Commission, with the limited revenue used principally for engineering. A gasoline tax of one cent per gallon was passed by the legislature in 1921 but none of the revenue went for highway purposes. It was divided between the school fund and the general fund.

The Federal-Aid Highway Act of 1921 greatly increased the amount of Federal-aid funds available for highway construction, requiring designation by each state of a Federal-aid Primary System not to exceed seven percent of the total road mileage.

Counties in Montana found it increasingly difficult to match available Federal-aid funds. In 1923 the gas tax was increased to two cents per gallon of which 40 percent went to county road funds and 20 percent to the State Highway fund. Progress continued slowly.

State Action

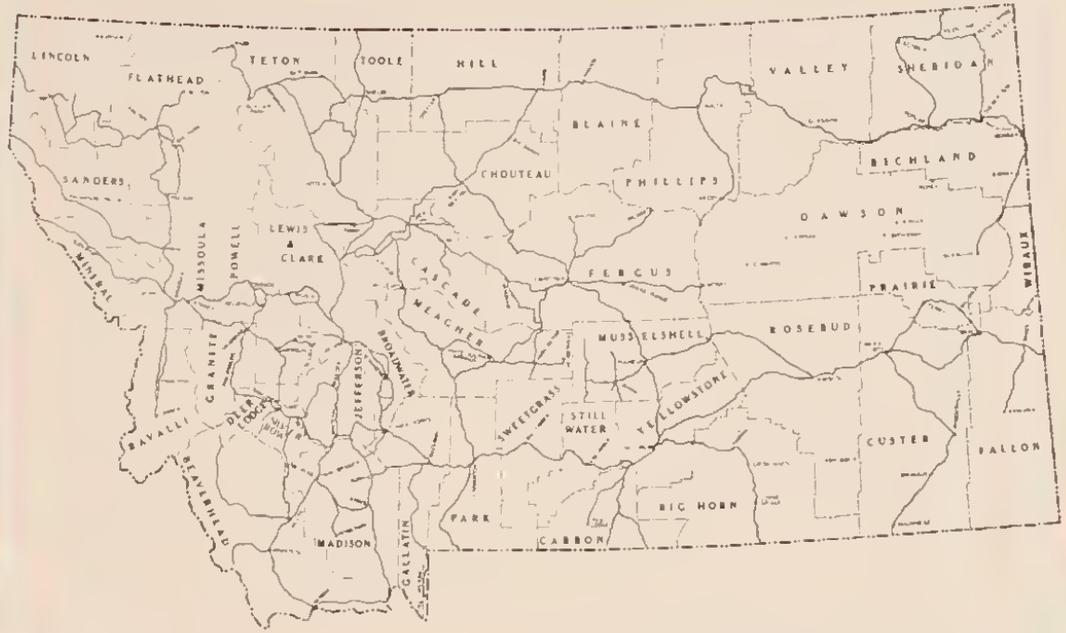
A change in policy, reflecting demand for greater state responsibility for roads, came in 1926 when the state gas tax was increased to three cents per gallon by Initiative Measure 31. The entire proceeds of this gas tax went to the State Highway fund. For the first time, the State Highway Commission could foresee sufficient revenue to provide for an expanded highway program. Shortly after the tax was raised to five cents a gallon in 1929, county contributions to State Highway construction practically ceased.

During the depression of the early 1930's economic activities lessened. A reduction in motor vehicle travel resulted in lower gasoline tax collections. Federal aid was increased through emergency funds to stimulate employment. To provide necessary matching funds, state bond issues of $6 million in 1931 and $3 million in 1937 were authorized. Much progress was made during this period in state highway construction.

World War II made it necessary to curtail activities to bare essentials. The war period was characterized by limited funds, reduced traffic, emergency construction only, and a maintenance program intended to keep highways in serviceable condition.

Following the war, Federal aid was greatly increased to assist in the extensive construction program necessary to overcome the accumulated de-

STATE HIGHWAYS IN 1914



ficiencies. Another period of increasing highway construction activity began. To provide needed matching funds, a $12 million state bond issue was authorized in 1949 and the gasoline tax was increased to six cents per gallon.

Federal Aid Acts of 1950, 1952 and 1954 further increased Federal aid. Again the state faced the problem of insufficient matching funds. To study the problem numerous interim highway committees were appointed by the governor. Several recommendations of these committees were enacted into law. These included reorganization of the State Highway Commission and establishment of a gross vehicle weight tax on commercial vehicles in 1952 and increasing the gasoline tax to seven cents per gallon in 1955.

County Roads

Since the middle 1920's county road responsibilities have been primarily confined to rural roads which are not State Highways. Principal county support for those roads has come from property taxes. A degree of state support is provided in that motor vehicle registration fees are retained for county road purposes in the county in which vehicles are registered.

Federal aid legislation in 1944, and subsequent acts, provided Federal assistance for construction of farm-to-market roads. In Montana, Federal-aid Secondary funds are matched from the State Highway fund but all construction is confined to a Federal-aid Secondary System comprised entirely of county roads. This system at present includes about 4,000 miles of principal county roads in all 56 counties of the state. Mileage is gradually being added as need arises.

Municipal Streets

With the exception of State Highway routes through cities, construction and maintenance of city streets is solely the responsibility of the municipalities. Property taxes and special assessments provide the principal sources of support. With the exception of special legislation applying to three cities only, Butte, Walkerville, and Anaconda, there is no state support for city streets, other than urban State Highways. State responsibility for maintenance of urban extensions is not uniform or complete.

Total Revenues and Expenditures

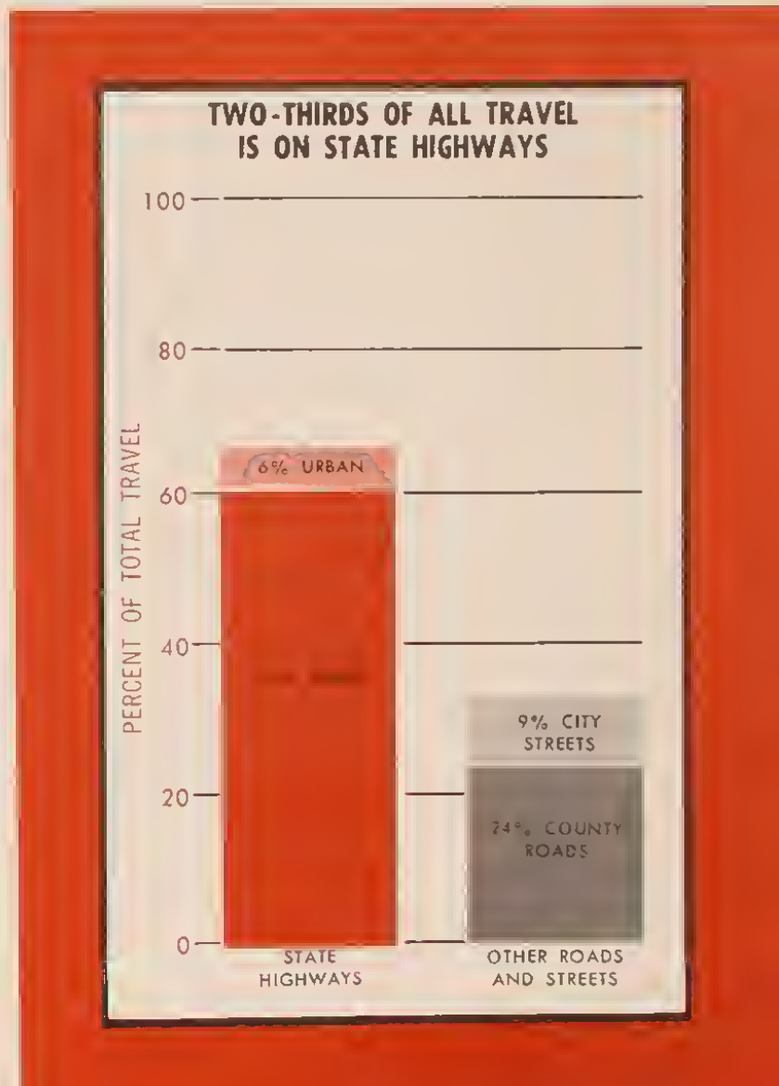
Construction and upkeep of the state's road and street network have become big-business. In 1955 highway and street revenues from all sources exceeded $40 million; total expenditures were almost $39 million. The chart on page 14 shows a breakdown of the revenues by source, their distribution to the 180 different governmental agencies responsible for the state's road and street network, and total expenditures by systems. State revenues and expenditures shown on this chart are for the 1955 calendar year; those for counties and municipalities are on a fiscal year basis.

CHARACTERISTICS OF HIGHWAY TRAVEL

Travel by Montana residents and visitors from other states and Canada reached an estimated total of 2.7 billion vehicle miles in 1955. Naturally, this travel was not evenly distributed over all the 72,500 miles of the state's roads and streets, or evenly spread over the hours of day, the days of the week, or months of the year.

Rural roads, which account for 98 percent of the total mileage, carried 85 percent of the total travel. City streets, including urban extensions of State Highway routes, carried 15 percent of the total travel. Two-thirds of the travel was confined to State Highways which comprise only eight percent of the total road and street mileage; 24 percent of the travel was on rural county-

State Highways are the backbone of motor transportation, serving every facet of economic and social life in Montana.



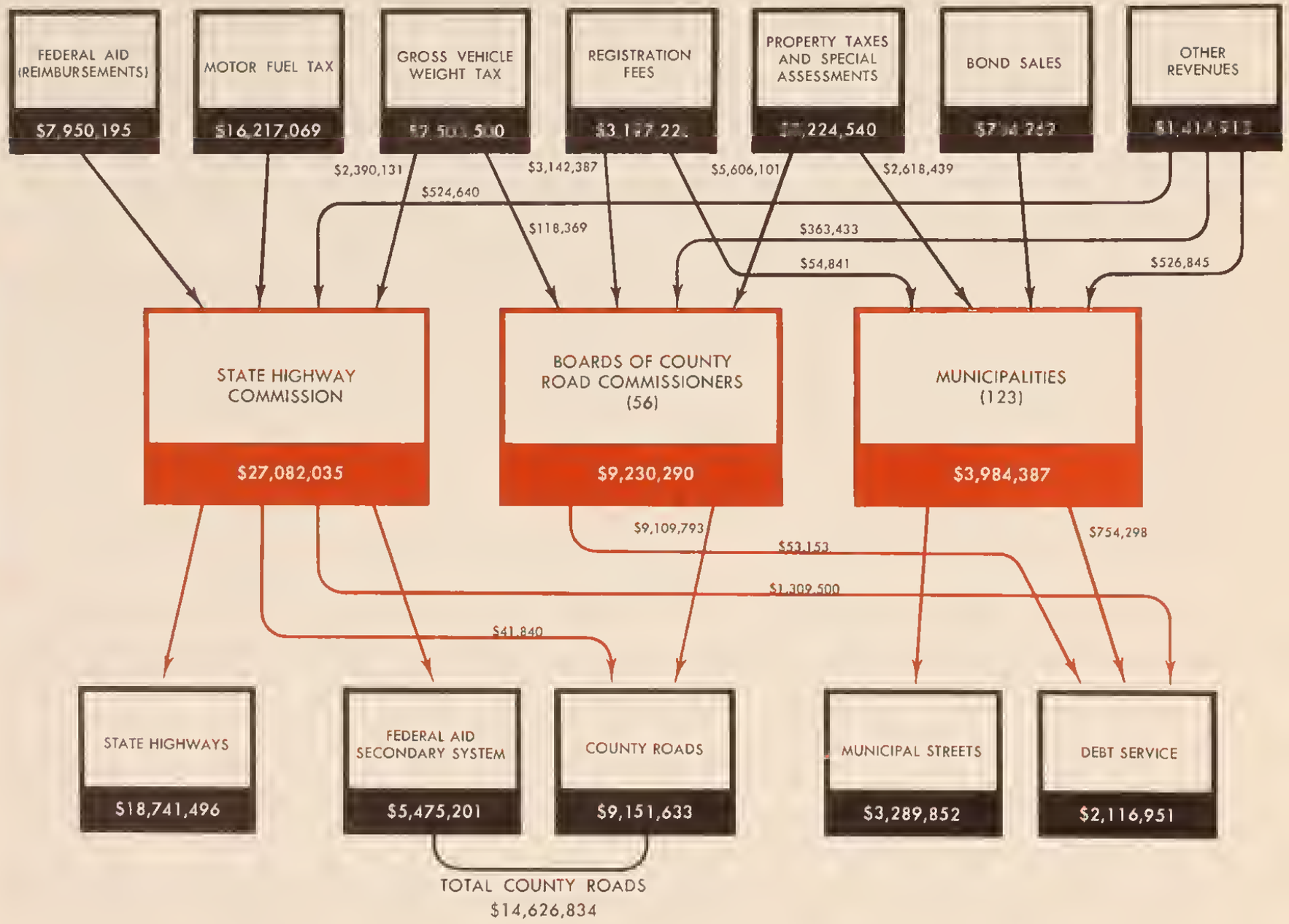
HIGHWAY AND STREET REVENUES AND EXPENDITURES

1955

REVENUES
$40,296,712

DISTRIBUTION

EXPENDITURES
$38,775,173



Difference Between Revenues and Expenditures Is Due to Opening and Closing Balances

maintained roads and nine percent on city streets other than urban State Highways.

State Highways

The map on page 8 shows by width of bands average daily travel on State Highways. Traffic is greatest in and adjacent to the major cities and along those routes connecting them. On the portion of U. S. 10 west of Billings, daily volumes approaching 10,000 vehicles are reached. About 25 miles of rural State Highways carry traffic in excess of 5,000 vehicles per day and about 100 miles carry in excess of 2,500 vehicles per day. In contrast, about 250 miles carry traffic of less than 100 vehicles per day. On the average, traffic on rural state highways is about 750 vehicles per day.

County Roads

The 4,000 miles of county roads on the Federal-aid Secondary System carry about eight percent of the total annual travel. Traffic on these roads averages 150 vehicles per day. About 20 miles carry traffic volumes in excess of 1,000 vehicles per day and about 150 miles carry less than 25 vehicles per day.

Traffic on the remaining 54,000 miles of county roads averages less than 20 vehicles per day, yet the total vehicle miles of travel on these roads is more than one million daily. More than a third of this mileage consists of seldom used unimproved trails which are impassable much of the year.

City Streets

City streets, while only two percent of the total road and street mileage, carry about one-seventh of all travel.

About 40 percent of all city travel is in the three cities of the state having populations in excess of 25,000; 31 percent is in the 10 cities with populations between 5,000 and 25,000, and 29 percent is in the 110 cities of under 5,000 population. Traffic on urban extensions of State Highways averages about 2,200 vehicles per day. Traffic on all city streets averages about 750 vehicles per day.

Time Variations in Travel

Travel varies in amount among the months of the year, the days of the week and the hours of the day.

Seasonal Variations

Variations in monthly travel are greatest on rural roads serving recreational traffic primarily. Traffic on this class of roads reaches a peak during the months of July and August when average volumes are 2.5, or slightly more, times as great as the average monthly traffic through the year. In contrast, traffic on recreational type roads during the period of December through March averages about one-third of the average monthly traffic through the year.

The peak on other rural highways is also reached during July and August, but the respective values are only about 1.4 times the average monthly traffic.

On urban arterials, seasonal variations are less pronounced. The peak, in August, is only 1.2 times average monthly traffic.

Daily Variations

Variations in daily traffic, both in rural and urban areas, are not as great as the seasonal variations. The peak on urban arterials is reached on Saturday, reflecting week-end shopping. The peak on rural highways occurs on Sunday when pleasure driving is greatest.

Hourly Variations

In rural areas the highest hourly volumes occur between 4 and 5 p.m. when traffic is about twice that of the average hour of the day. The low point is between 3 and 4 a.m. Traffic during the 10-hour period between 8 a.m. and 6 p.m. is more than twice that which occurs in the remaining 14 hours of the day.

In urban areas, where industry and business have greater influence on travel, hourly variations are quite different. Lowest volumes occur between 4 and 5 a.m. The peak is between 5 and 6 p.m., but is less pronounced than the peak hourly rural traffic. A greater proportion of urban travel occurs during the evening hours of 6 p.m. to midnight. Traffic during the 10-hour period between 8 a.m. and 6 p.m. is only about 1.5 times that which occurs in the remaining 14 hours of the day.

Hourly traffic patterns, rural and urban and by class of road, provide a base for determining the frequency with which peak traffic volumes occur. With such information, engineers identify the extent and degree of congestion on existing facilities and can plan with confidence the corrective measures necessary for relief.

Who Travels Where

Rural residents comprise 45 percent of the state's population; urban residents, 55 percent. Rural residents own 43 percent of the passenger cars registered and 78 percent of all trucks. Fifty-three percent of all motor vehicles are owned by rural residents who account for 48 percent of the total statewide motor vehicle travel. Urban residents own 47 percent of all motor vehicles and do 52 percent of the total statewide travel.

The annual travel per motor vehicle owned by urban residents is about 20 percent greater than the average annual travel per motor vehicle owned by rural residents.

Rural residents do about 92 percent of their

travel in rural areas and about 8 percent in cities. Urban residents drive slightly over three-fourths of their mileage in rural areas and one-fourth in cities.

Rural residents account for 46 percent of the travel on rural State Highways, urban residents 54 percent. Rural residents do 72 percent of the travel on county roads and 27 percent of the travel on city streets. Urban residents make up 28 percent and 73 percent of the travel on county roads and city streets respectively.

Reasons for Travel

More than a third of all passenger car travel by Montanans has to do with earning a living — trips to and from work and other trips directly associated with business and professional activities. Another third of total passenger car travel is for family business: i.e., shopping, education, medical, religious and related purposes. The remaining travel is for social and recreational purposes. This includes vacation trips occurring generally once a year but on the average involving round-trip travel of about 500 miles in the state.

Trends in Truck Travel

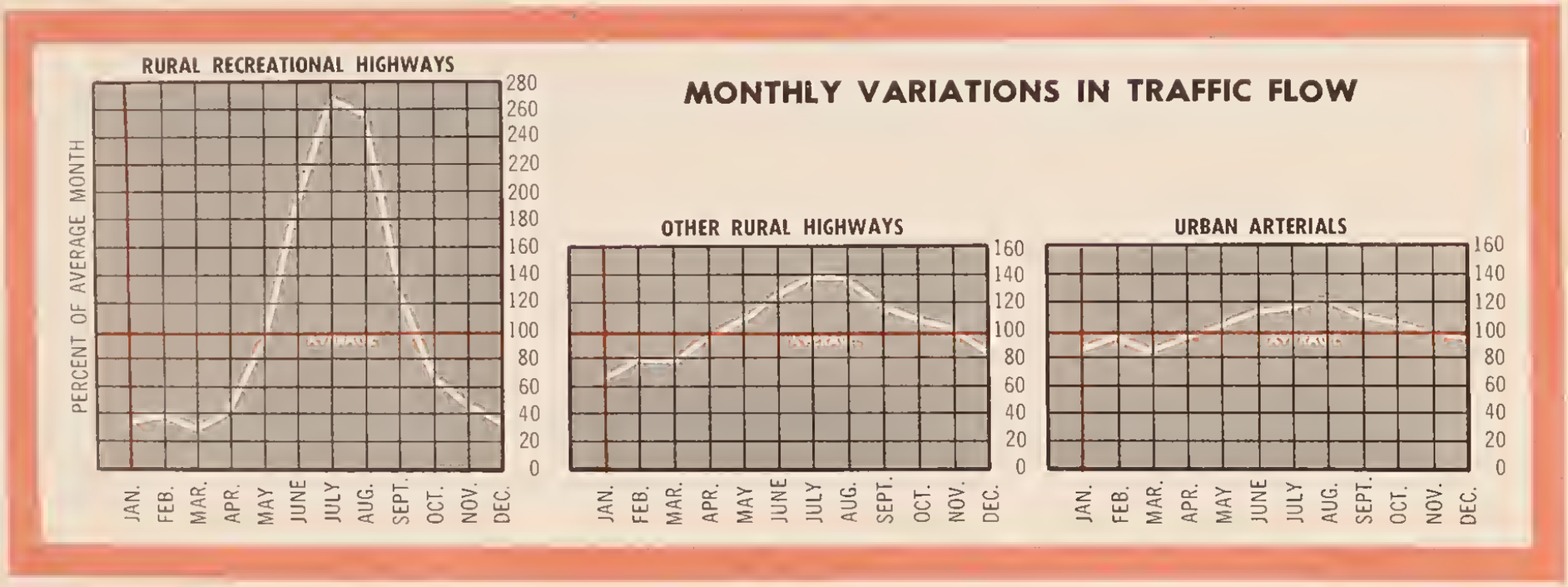
The number of trucks registered in Montana last year exceeded 100,000 — about 2.5 times the number registered 20 years ago. During this same period passenger car registrations increased about 1.9 times.

Not only has the number of trucks greatly increased, but there has been a decided trend upward in use of larger vehicles. In 1936, of all commercial vehicles observed at weighing stations on rural State Highways, 97 percent were single-unit trucks with the remaining three percent being tractor-semitrailer and truck full-trailer combinations. By 1954 the single-unit trucks had dropped to 79 percent. Tractor-semitrailer combinations composed 15 percent of the commercial traffic and truck-full trailer combinations the remaining six percent.

Loaded Weights

The average weight of loaded single-unit trucks increased from 3.0 tons in 1936 to 5.5 tons in 1954. The increase in weights of the larger vehicles was more pronounced:

Vehicle Type	*Average Loaded Weight* 1936	1954
Tractor-Semitrailer combinations	10.6 tons	23.3 tons
Truck-Full Trailer combinations	16.5 tons	32.7 tons



For all trucks the average loaded weight more than doubled, from 4.2 tons in 1936 to 10.4 tons in 1954.

Increases in sizes and weights of trucks have greatly influenced the design of highways in recent years and will continue to do so. The increases reflect the growing dependence on truck transportation in movement of commodities and essentiality of trucks to the state's economical well-being.

THE ROLE OF HIGHWAYS IN MONTANA'S ECONOMY

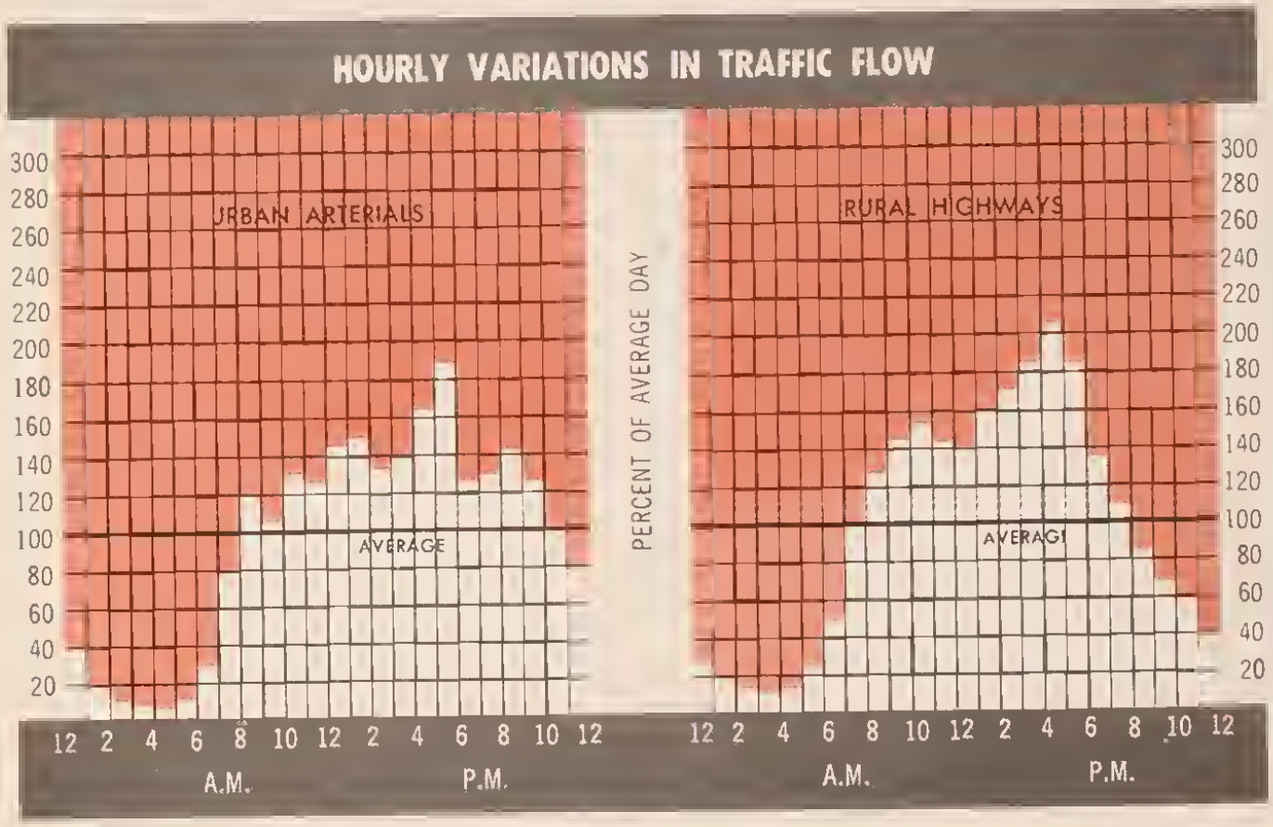
Much of Montana's economy and many of the important daily services taken for granted in today's way of life are dependent upon highway transportation.

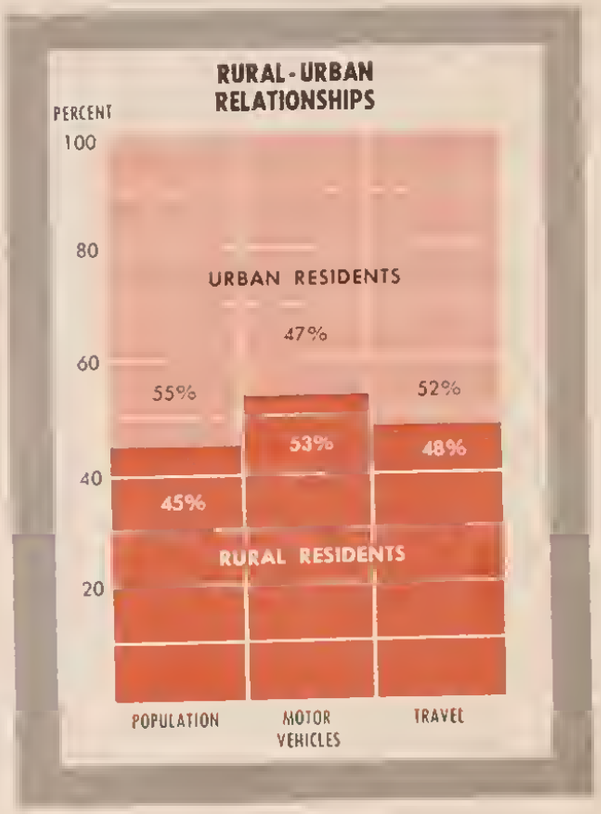
Recent studies have related transportation requirements to the gross national product, a measure of the nation's economy. Those studies show a markedly constant relationship over the last quarter century. To create one dollar of gross national product, 6.2 ton-miles and 2.3 passenger-miles of transportation are consumed. To push forward to higher economic levels requires an excess of transportation capacity always ready for use. Of all the forms, highway transportation is the universal complement; it starts and completes most trips by air, rail or water in addition to all movements over highways alone.

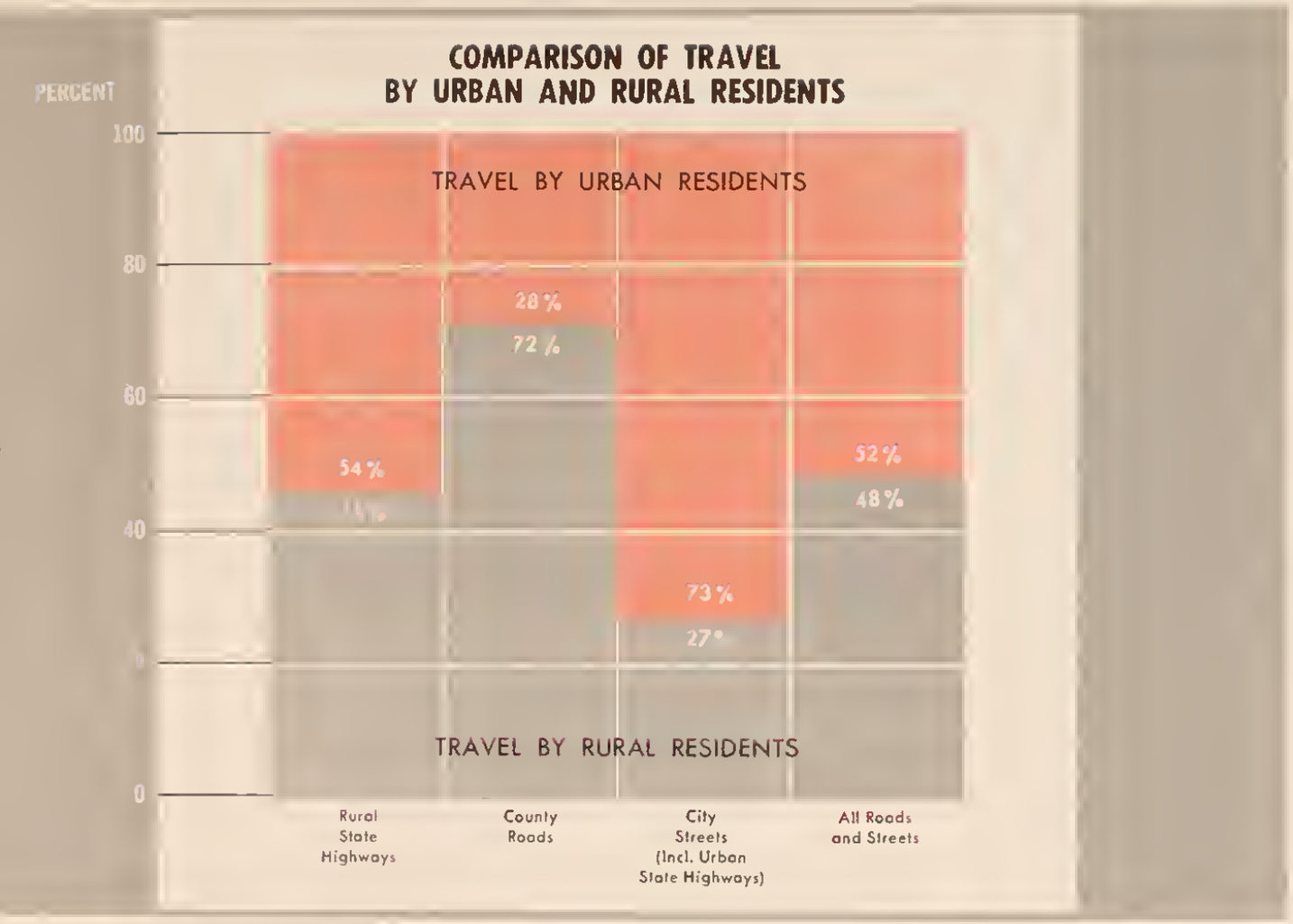
Highway transportation assumes great importance in Montana with its vast area and sparse distribution of population. While the state is served by three major east-west railroads, more than a third of its total area is more than 25 miles from railroads with regularly scheduled service.

Of the 505 cities, towns and small unincorporated communities in the state, 137 are not served by railroads. Consequently, they are completely dependent on highway transportation. Of those places, six are incorporated cities, including three county seats, Broadus, Ekalaka and Jordan.

The importance of highways is reflected by the ratio of population to motor vehicle registration. Ranking forty-second among the states in population, Montana is fifteenth in the number of persons per passenger car and second in the number of persons per truck. Only neighboring







Wyoming has a lower ratio of population to truck registration.

Highway transportation has made it possible to extend services such as telephone, electricity, gas, water supply, home delivery of foods and merchandise, newspapers, milk and countless other items to rural and suburban families as well as city dwellers. Such services have become so commonplace that the fact they are dependent upon highway transportation is frequently overlooked.

Agriculture and Livestock

Agriculture, the largest economic industry in the state is highly dependent on highway transportation. The day of the self-sufficient farm has gone. Farmers and ranchers no longer raise the greater part of their food and rarely do they stock food or fuel supplies in sufficient quantity to last through the severe winter months. They have become nearly as dependent on packaged foods, the supermarket and daily services as the city resident.

Total crop production on Montana farms in 1953 amounted to $327 million. Of that production about a third was fed to livestock, retained for seed, consumed on farms or stored, and two-thirds was marketed. All produce marketed was hauled from farms to grain elevators, shipping points, or market centers by motor vehicle. While eventual movement of most farm products from elevators and shipping points to eastern or western markets is by rail, there is an increasing use of truck transportation for long distance hauling of grain, particularly as cargoes for empty out-of-state trucks crossing the state on return trips.

In addition to marketing crops, livestock and livestock products account for a substantial part of the agricultural income in Montana. During 1953 cash sales of livestock amounted to $117 million; sales of livestock products to $42 million. Practically all of this production moved from farms and ranches by motor truck.

Highway transportation has greatly changed ranchers' marketing practices. Trailing of cattle to market, a common practice so late as 20 years ago, is a rare occurrence today. The speed and flexibility of trucks in hauling cattle, combined with the worthwhile savings in weight loss, have contributed to the abandonment of trailing practices in most instances.

Mining and Minerals

Mining and mineral production is second to farm and ranch production in Montana. In recent years mine and mineral production has averaged about $125 million a year, including petroleum and natural gas.

Mines in the Butte area produce about half of the value of all mineral production in the state. Nearly all of the entire output from these mines moves by rail to the smelter, and the products from the smelter move by rail to markets or other points.

However, a number of other mining areas are located in high or remote places inaccessible to railroads, so trucks provide the only means of getting ore from these mines to the smelter or shipping point. One example of the part truck transportation plays in movement of chrome ore is found in southwestern Stillwater County. Present production from this area is over three-fourths of the total chrome ore production in the nation. The entire output of ore concentrates is moved by motor truck. The average hauling distance from the mines to a shipping point is 35 miles.

Although principal coal mines are located on railroad lines, there are numerous small coal and lignite mines which supply local needs. Trucks are used almost exclusively to transport the products of smaller mines.

Transportation requirements in the petroleum industry are served almost entirely by truck up to the point of actual production. The huge drilling rigs move in sections by truck from one drilling site to another. In addition, supplies, fuel, pipe, machinery and other essential items move to each site by truck. While the bulk of crude oil production in the state is transported by pipeline or railroad, recent figures show that trucks carry about 20 percent of total production. This is mostly from smaller fields and individual wells. A large portion of refined petroleum products move from pipeline and railroad terminals by motor truck to bulk plants. Distribution from bulk plants to service stations, garages and large individual consumers is entirely by truck.

Tourist Industry

Valued at about $87 million per year, tourist trade ranks as the third largest economic factor in the state. About 85 percent of the 3 million tourists to Montana in 1954 traveled in some 800,000 automobiles. This represented about four out-of-state passenger cars to each passenger car registered in the state. The average tourist party drives about 600 miles in the state and stays for about four days. Per capita expenditure averages $29 within the state.

It is generally recognized that all segments of the state's economy benefit from tourist business. The Montana Chamber of Commerce reports 23 percent of the tourist dollar goes for food, 19 percent for lodging, 23 percent for oil, gas and transportation expenses, 20 percent for retail purchases, 11 percent for amusements and four percent for other expenses.

Most out-of-state travelers are on vacation trips; they have long evidenced a natural aversion to rough, dusty or otherwise inadequate roads. As many states have learned, modern roads encourage additional time and travel in a state. It

Farm trucks await their turn to unload at a grain elevator. Most Montana farm products today are transported to market or railheads by highway.

is estimated that a one-day increase in the average length of tourist visits would add 25 percent or $20 million per year in the amount of Montana tourist trade.

Forestry

Forestry is another major industry relying heavily on highway transportation. Fourth largest in forest area among the states, Montana is twelfth in lumber production and provides one-seventh of the nation's Christmas trees. Nearly all forest products move to mills or shipping points by motor truck.

School Transportation

In recent years the trend has been pronounced toward consolidation of school districts. Isolated one-room schoolhouses are rapidly being replaced by better, more economical consolidated schools.

During the 1953-1954 school term, public assistance for transportation was provided for 32,500 pupils throughout the state. Families of 8,300 pupils were granted allowances for use of private motor vehicles in transporting children to school. In addition 24,200 pupils were transported by school bus. This involved the use of over 700 buses, with average trip lengths of about 28 miles. Total passenger miles of transportation by school bus was approximately 80 million for the school year.

Postal Service

Rural mail delivery is an important service in Montana. Vast areas are remote from railroads and distances are great between major cities. Rural mail delivery is entirely by motor vehicle.

Postal routes are divided into two general classes. Rural delivery routes, involving the deposit of mail in individual boxes at points along the route, are located on 7,000 miles of rural

School bus transportotion is an integral part of Montono's educotionol system. In o recent school term, school buses troveled 80 million possenger miles.

Procticolly the entire production from forestry operotions in Montono moves to mills or shipping points by motor truck.

roads or about 10 percent of all rural roads in the state.

Star routes, for delivery of mail from central points served by rail lines to post offices in outlying communities, number about 400 and cover over 17,000 miles of roads. Combined, rural delivery routes and star routes equal more than one-third of the total rural road mileage of the state.

Highway Transportation Industry

About 62,000 persons in Montana are employed in industries directly related to highway transportation. This includes automobile and truck dealers, repair shops, petroleum production and refining, highway agencies, road workers, gasoline service stations, common and contract haulers, automobile appliance stores and other similar businesses. This total employment is equal to about 10 percent of the total population and to about 25 percent of the total labor force in the state.

FUTURE TRAVEL

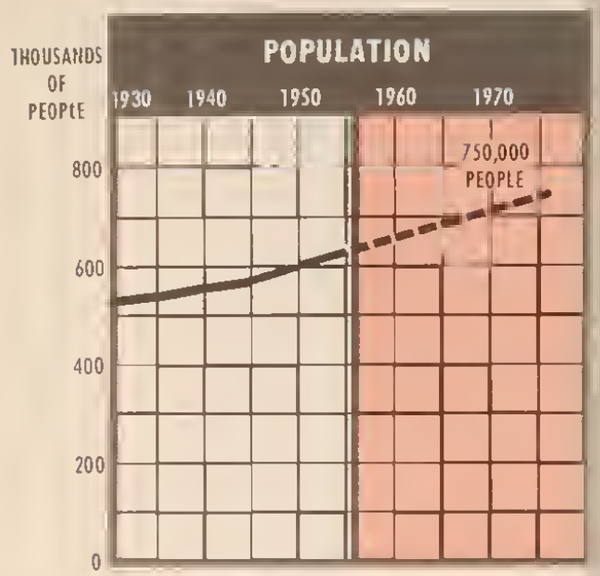
As the state's economic activity increases, more highway traffic is generated and the demand for highway service is intensified. A vital step, therefore, in development of long-range programs for bringing the road and street networks up to adequacy, is consideration of probable future traffic demands. Highway improvements are a capital investment for many years of service. Facilities designed to meet the requirements only of today's traffic would be obsolete long before their physical life had been expended. Experience over the years has demonstrated this.

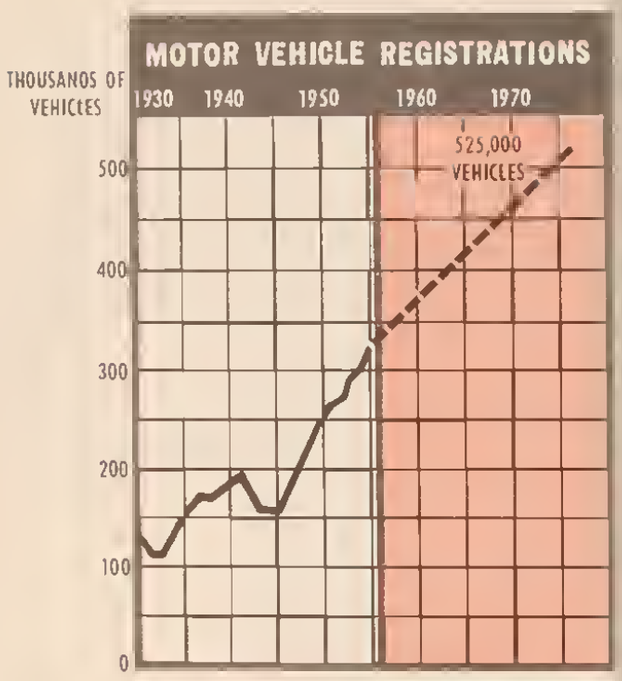
The amount of highway travel which must be served in the next 20 years has been estimated, based upon a study of three factors — population, motor vehicle registrations and gasoline consumption per vehicle.

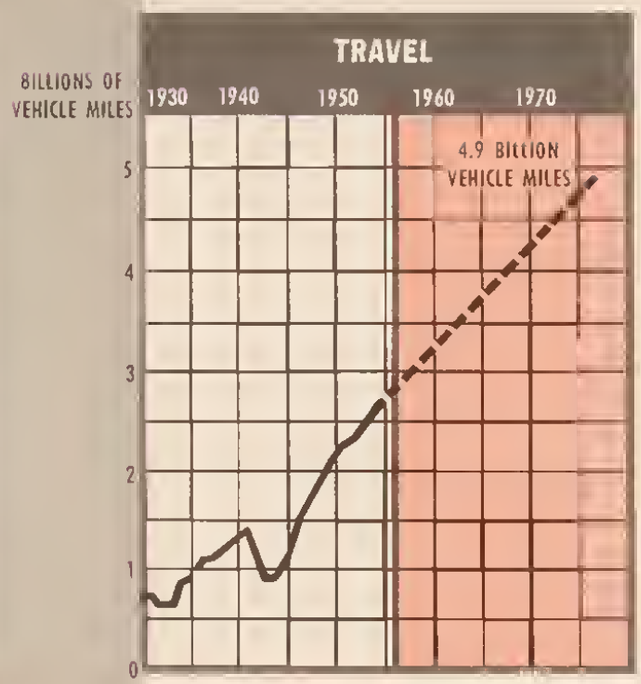
Census statistics show a rather steady rate of population growth in Montana in the last two decades. From a total of about 539,000 in 1930, population increased to 591,000 in 1950. The 1955 mid-year population estimate for the state was 628,000 — an increase of about six percent over 1950 and about 16 percent over 1930.

On the basis of Census Bureau population studies and on the assumption that the recent trends in birth rate and migration will continue substantially unchanged, Montana population is

One-third of motor vehicle travel in Montana is for recreational and social purposes. Montana has much to offer the vacationer — for example, good riding horses and lazing under the Western sun, and majestic beauty such as this view in Glacier National Park, site of the famous "Alps of the Americas." Indeed, the state's tourist attractions meet with little rivalry anywhere in the country. For the growth of the important travel industry, adequate roads are a necessity.







expected to increase about 19 percent by 1976. The population should reach 690,000 by 1966 and 750,000 by 1976.

Motor vehicle registrations grew from 135,000 in 1930 to 330,000 in 1955. The 1955 registrations represent a 60 percent increase over 1940 and are approximately double the number of vehicles registered in 1945 at the close of World War II.

In 1930, there were 4.0 persons in the state for each registered motor vehicle. By 1940, this ratio was 2.9. The rapid growth in registrations in the post-war period brought the ratio of persons per vehicle to 1.9 in 1955, substantially ahead of the United States average of 2.7.

On the basis of continuing economic growth, the trend in registrations is expected to continue upward in the future, but at a somewhat slower rate than prevailed in the last 10 years.

Motor vehicle registrations are estimated to reach 419,000 by 1966 and 525,000 by 1976, an increase of about 59 percent over 1955. On this basis, the ratio of persons per vehicle will be about 1.4 in 1976.

Since 1930, the trend in highway travel has generally paralleled the increase in motor vehicle registrations. In 1930, gasoline consumption per vehicle averaged 450 gallons. By 1955, gasoline consumption per vehicle had grown to 700 gallons, an increase of over 50 percent. Because of the increasing number of multi-vehicle families, it is expected that motor fuel consumption per vehicle will increase at a more moderate rate in the future. Assuming a continuance of high-level economy and improved highways, gasoline consumption per vehicle should reach about 755 gallons annually by 1966 and 790 gallons annually by 1976.

The historical and projected trends in population, motor vehicle registrations and gasoline consumption forecast a sizeable increase in motor vehicle travel during the next 20 years. Total travel in Montana amounted to about 2.7 billion vehicle miles in 1955. With provision of adequate highways it is expected total motor vehicle travel will reach 3.8 billion miles by 1966 and 4.9 billion miles by 1976. Those increases are about 40 and 80 percent respectively over the 1955 state travel.

Rich in natural resources, Montana's economic progress rests largely on highway transportation facilities which make those resources readily accessible and useful.

Chapter 2

classification

MONTANA'S GREAT AREA requires an extensive mileage of roads and streets. With a relatively small population limiting the state's highway revenue it is imperative that the maximum efficiency be applied in the management of the road and street plant if the public is to get the transportation service it wants and needs. The first step toward efficient management is proper classification.

To bring the state's vast mileage of busy highways, important feeder roads, local roads and arterial and local streets to a satisfactory degree of adequacy is a job that requires the very best of engineering and planning, as well as sound classification and efficient management.

Defects in Montana highway laws add to the difficulty of making highway progress. There are numerous cases of conflicts, ambiguities and omissions. There is need for clear cut delegation of jurisdictional and management authority for the various classes of roads and streets and for a sound finance plan.

Montana's problem is not unique among the states, many of whose road and street responsibilities are the result of legislative and administrative action taken mostly without factual basis during the last 30 or 40 years.

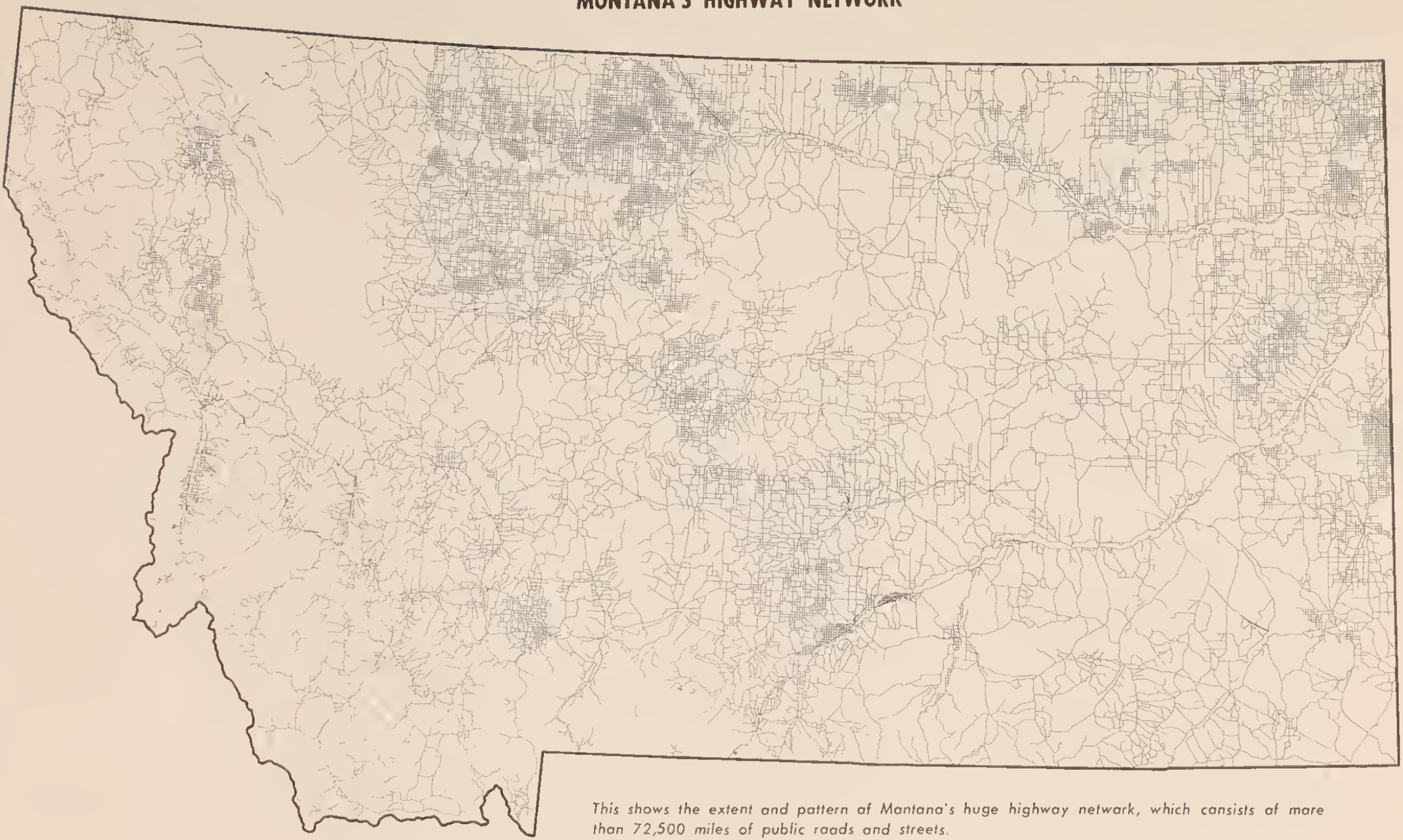
Under laws now on the books, Montana's highways and streets are known as State Highways, county roads and streets. This classification is solely on the basis of jurisdiction, with little regard to the function or service given by the highways and streets, particularly in the county and municipal areas.

PRESENT SYSTEMS

The state's huge highway plant consists of over 72,500 miles of roads and streets as shown on the map on page 24. Rural mileage totals about 71,000 miles of which approximately 5,700 miles are State Highways and 58,300 miles are under county jurisdiction. The remaining rural roads, about 7,000 miles, are special interest roads located in National Forests, Parks and other Federal Reservations. The special interest roads are entirely under Federal jurisdiction and are not within the scope of this study.

All roads and streets are important, particularly to the people who live along them. But their importance, economically and socially, varies widely. A relatively small mileage, less than 10

MONTANA'S HIGHWAY NETWORK



This shows the extent and pattern of Montana's huge highway network, which consists of more than 72,500 miles of public roads and streets.

This total mileage is equivalent to about 610 feet of road or street for each man, woman and child in the state. The network is administered by the State Highway Commission and 56 counties and 123 municipalities.

percent, forms the backbone of Montana's vast road and street network. Those are the arteries which connect the larger cities and serve the interstate and principal intrastate travel. At the other extreme, almost one-fourth of the rural mileage is little used trails which, in most cases, are a couple of wheel tracks meandering across the landscape. In between the two extremes there are the feeder roads which directly serve ranches, farms, mills, mines, villages and towns.

State Highways

Montana's State Highways at present consist almost entirely of those highways designated as the Federal-aid Primary System, which is comprised of 5,731 miles of rural road and 165 miles of urban streets.

State Highway routes are designated by the State Highway Commission. While the law delegating this authority to the Commission also provides for cooperation of the Boards of County Commissioners of the several counties in the state in route designation, the courts have held that this requirement covered only roads built and in use in counties when the Act was passed and not new State Highways thereafter laid out or built.

The legislature in delegating authority for designating State Highways imposed no limitation on the total extent of State Highway mileage nor does the law set forth specific criteria or controls for the selection of routes.

While early laws indicate that the State Highways shall be those on the Federal-aid Primary System, later legislation broadened the authority to cover other roads, as have been or may be authorized by state law, including connections to the Federal-aid Primary System for county seats not on that system.

Review of existing State Highway routes reveals that they generally have been well selected. There is a small mileage of designated routes, or portions of routes, which are non-existent as traveled roads today. There is a small additional mileage of existing routes on which no state construction has been performed. While these roads are of rather low priority they appear to form logical parts of an integrated State Highway network.

County Roads

Rural roads under the jurisdiction of the 56 counties total about 58,300 miles. The mileage per county varies from as little as 220 miles in Deer Lodge County to over 2,800 in Chouteau County. Differences are caused by variations in area, topography, nature of land use, population density, natural resources and other conditions.

The character and importance of county roads vary greatly. Some are principal feeder routes to State Highways. Some are the only means of access to small municipalities and unincorporated places. Some serve school bus and mail routes and are essential to year-round access to rural farms and dwellings. Some consist of streets in rural subdivisions adjacent to the larger municipalities. Some are unmaintained trails, impassable several months of the year, and are of seasonal importance only.

Despite those differences, state laws contain no provisions for classification of county roads according to service characteristics. There is a partial administrative classification in that about 4,000 miles of the more important county roads comprise the Federal-aid Secondary System. However, designation of the Federal-aid Secondary System is not complete. Additions are being made county by county as need arises. Consequently, there is considerable variance at present between counties in the ratio of Federal-aid Secondary System mileage to total county mileage.

Costs of construction and maintenance of county roads are partially financed by the state through motor vehicle registration fees which are retained for road and street purposes in the county where the vehicles are registered. Present laws contain no provisions for state engineering or supervisory control over expenditures of these state-support funds, nor is there any requirement for county matching. As a result a few counties with comparatively large motor vehicle registration finance their roads almost entirely from motor vehicle registration fees, whereas many counties, because of small motor vehicle registrations, are compelled to levy the highest property tax permissible for road purposes under state law to meet the needs of a minimum road budget. It is paradoxical that some counties levying no property tax, or less than the maximum, have a greater relative road need than many of the counties which have been forced to a maximum effort of local support because of the small amount of receipts from motor vehicle registration fees.

In general, matching funds for Federal-aid Secondary projects come from the State Highway Construction Fund. Under this arrangement the State Highway Commission has primary responsibility for design and construction supervision, with the counties responsible for maintenance. This method of operation, even with the best of intergovernmental relations, has the disadvantage of divided authority. This is contrary to good management principles.

Municipal Streets

Responsibility for city streets, with the exception of State Highway routes through cities, is in the hands of city officials. State laws make no

provision for classification of streets, according to service characteristics, which are under the jurisdiction of cities. In larger municipalities, the volume of traffic on certain streets has led to their designation as "through or arterial streets." This is a form of classification based on usage, but the principal purpose of such designations is for control of traffic and not for financing or management reasons.

Property taxes and special assessments provide the principal sources of revenue for city street construction and maintenance. Unlike rural county roads, there is no state financial assistance, except for urban State Highways and for three cities. Butte, Walkerville and Anaconda. By special legislation those cities share in the motor vehicle registration fees collected in Silver Bow and Deer Lodge Counties.

Existing administrative policies of the State Highway Commission generally require financial participation by cities in the construction of urban State Highway projects. Also, in general, costs of appurtenances to urban State Highways, such as storm sewers, street lights, sidewalks, etc., are financed partly or entirely by the cities without state assistance. State responsibility for maintenance of urban State Highways is not uniform or complete, particularly in regard to traffic service operations such as snow removal, ice control, flushing, sweeping, lane striping, etc.

Two-thirds of the total motor vehicle travel in Montana occurs on State Highways. Usually, as on this portion of US-10 west of Miles City, trucks constitute a substantial proportion of the traffic.

Federal-aid Systems

Use of Federal-aid funds in Montana, as elsewhere, is limited to approved construction work on fixed systems selected by the state and approved by the U. S. Bureau of Public Roads. Federal-aid legislation defines construction to include necessary rights of way, and direct project engineering, but excludes maintenance and upkeep costs.

There are three Federal-aid Systems:

1. The National System of Interstate and Defense Highways
2. The Federal-aid Primary System, of which the Interstate System is a part, and
3. The Federal-aid Secondary System.

These systems are administrative in nature and coincide with portions of established state and county roads and municipal streets.

BASIC PROBLEMS NEEDING REVIEW

Examination of existing road and street systems and Montana laws and policies pertaining to highway classification and responsibilities has raised the following fundamental questions:

Is the absence of legislative control on the extent of State Highway mileage desirable?

Are present systems adequate and properly selected?

Is it necessary and advisable for construction and maintenance responsibility on the Federal-aid Secondary System to be divided between the state and counties?

Is the state's interest in arterial city streets comparable to that in rural roads?

Is it desirable to have no state engineering and supervisory control over expenditures by the counties of proceeds from motor vehicle registration fees?

Are existing constitutional and legislative limitations on county and municipal road and street finance reasonable and proper?

Future decisions of the Fact Finding Committee and the legislature on these questions will have important bearing on road and street development. Decisions reached must be related firmly to a finance plan which will enable highway agencies to develop the several integrated road and street systems in a progressive and orderly fashion.

THE BASIS FOR ROAD AND STREET CLASSIFICATION

Engineering principles of orderly and sound highway classification involve grouping roads and streets according to the predominating type of service given to users. Analysis of motor vehicle travel revealed that Montana roads and streets fall into three general classes of usage:

(a) Those of statewide interest

(b) Those of community interest

(c) Those of local interest.

Routes of statewide interest are identified by their location in connecting the seats of state and county government and other principal communities of the state and neighboring states; by the greater volumes of traffic served; by their superior service to the national defense and by their usage by long-distance commercial and passenger motor vehicle travel.

Rural routes of community interest are distinguished by one or more of the following characteristics:

1. Serve as principal feeders to routes of statewide interest
2. Connect cities, towns, communities, shipping points and markets within a county or within adjacent counties
3. Give access to rural churches, schools and community meeting halls
4. Serve as main arteries for rural mail and school bus routes
5. Act as collectors of traffic from several roads of local interest
6. Occur at reasonable intervals consistent with the density of population.

Municipal streets of community interest are those that:

1. Connect with rural roads of community interest and carry traffic into and through cities
2. Serve points of traffic interest within a city
3. Form a system of streets upon which traffic can be controlled and protected to provide optimum movement.

Roads and streets of local interest are those whose principal use provides access to farms, forests, mines, grazing lands, etc., in rural areas and residences and business establishments in cities. Roads and streets in this class carry relatively little traffic and primarily accommodate the people who live along them.

Rural Classification Plan

The rural classification plan developed for this engineering study involved an examination of the 64,000 miles of state and county rural roads in Montana and the grouping of them into three interconnected systems:

1. A Primary System providing statewide service
2. A Secondary System of community interest roads
3. Local rural roads primarily providing access to land.

Roads included in the Primary and Secondary study systems were selected by state and county highway officials in cooperation with members

WHY PROPER CLASSIFICATION?

The first step in this engineering study was to group all highways and streets into systems, applying criteria or standards, adjusted with careful regard to Montana conditions. The objectives of this classification are —

1. To establish logical, integrated systems which bring together those roads and streets which should be under the same jurisdiction because of the service they render.
2. To bring together in a group these roads and streets which require the same degree of technical competence in their design, construction, maintenance and operation.
3. To assign responsibility over each class of roads and streets to the level of government having the greatest basic interest.
4. To provide a basis for efficient management and inter-governmental coordination so as to avoid conflicts regarding administration, finance, standards and priorities.
5. To establish a basis for long-range programming and fiscal planning.

PROPOSED PRIMARY AND SECONDARY ROAD SYSTEMS

Primary routes of statewide interest are shown in black; Secondary routes are shown in red. The combined systems serve every incorporated community, as well as all rural areas, and carry 93 percent of all rural travel. The proposed Primary and Secondary Systems represent but one-fourth of the state's total road and street mileage.

of the Foundation engineering staff. The routes comprising each system met the criteria and guides previously discussed.

Proposed Primary System

The proposed rural Primary System totals 5,930 miles. It includes all proposed route locations of the National System of Interstate and Defense Highways, the Federal-aid Primary System as of January 1, 1956, and about 200 miles of connecting links, bypasses of incorporated places and spurs. No existing State Highways are omitted from the proposed system.

Routes on the proposed Primary System directly serve 98 per cent of the urban population of the state. The system reaches all rural areas at reasonable intervals and provides service for all major interstate and intrastate traffic movements.

While only about eight per cent of the total rural mileage, the routes of the proposed Primary System carry about 77 per cent of total rural travel.

This group of roads of statewide interest logically should constitute the rural portion of a State Highway System. While future changes in the network may be necessary to meet changes in travel habits, the total mileage should not be materially changed. This is evidenced by the fact that inclusion of additional routes would only slightly increase the amount of total rural travel served.

Prapased Secandary System

The proposed Secondary System totals 12,100 miles in length. It includes all routes of the present Federal-aid Secondary System. The mileage per county varies from 41 miles in Deer Lodge County to 569 miles in Chouteau County.

Routes comprising the proposed Secondary System accommodate 16 per cent of the total rural travel in the state. Traffic on a typical mile at present amounts to 75 vehicles per day.

The Secondary System routes within each county are primarily of community interest to all residents of the county. As such, complete responsibility for development and maintenance of the system should be placed with the counties. For effective and efficient operation, Boards of County Commissioners should be responsible for establishment of policies and broad administrative decisions. Management and engineering responsibility should be vested in full-time registered engineers or road superintendents. To carry out the long-range development plans discussed later, system management should be firmly coupled with a suitable financial policy established by the legislature. The finance plan should involve state assistance. Consideration should be given to adopting the principles of state and Federal-aid relationships which have proved so effective over the years.

Complete county management responsibility for the Secondary System could not be placed in effect immediately in all counties since many do not now employ county engineers. Nationwide, there is a shortage of qualified engineers and recruitment of competent personnel for the county engineer positions will require some time.

Until individual counties are in a position to meet basic management requirements, as the legislature may establish, development of the Secondary System in those counties should be the responsibility of the State Highway Commission. To insure that this would be a temporary arrangement, the legislature should establish a fixed period of time for transfer to county management responsibility.

Lacal Rural Roads

Outside the proposed Primary and Secondary Systems, there are about 46,200 miles of county roads which are of strictly local interest and should remain under county responsibility. Included are some 14,000 miles of trails on which an adequate degree of traffic service can be provided for many years to come by means of nominal maintenance expenditures only.

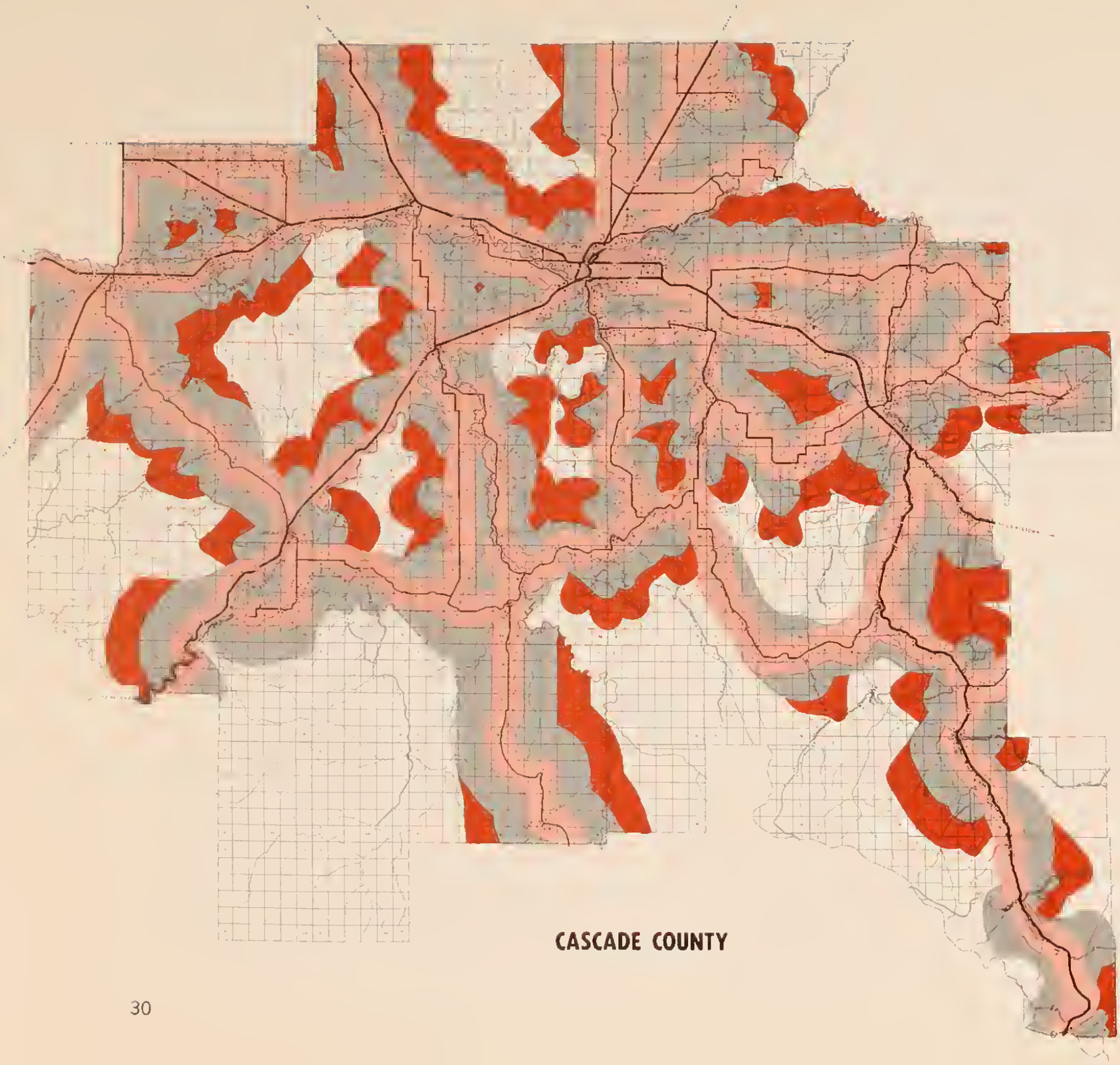
While comprising the bulk of all rural road mileage, the 46,000-odd miles of local roads serve only seven percent of all rural travel. Traffic on a typical mile averages eight vehicles per day.

Service Pravided by Primary and Secandary Systems

The proposed Primary and Secondary Systems are shown on the map on page 28 superimposed on a population density map of the state. The combined systems serve every incorporated community as well as all rural areas. The road network is more closely spaced in the rural areas where population density is highest and is further apart in the sparsely populated areas. The two systems combined, while only a fourth of all rural mileage, serve 93 percent of all rural travel.

Detailed examination of several counties representative of the state's major economic and geographic areas reveals that approximately 82 percent of farm dwellings and rural residences are within one mile of the routes comprising the proposed Primary and Secondary Systems; 90 percent are within three miles; 97 percent are within five miles and only three percent are over five miles away. The maps of Sheridan and Cascade Counties on pages 30 and 31 show the relationship of proposed Primary and Secondary Systems to rural dwellings in those counties.

Improvement of the proposed Primary and Secondary Systems to standards adequate for present and future traffic will greatly benefit rural



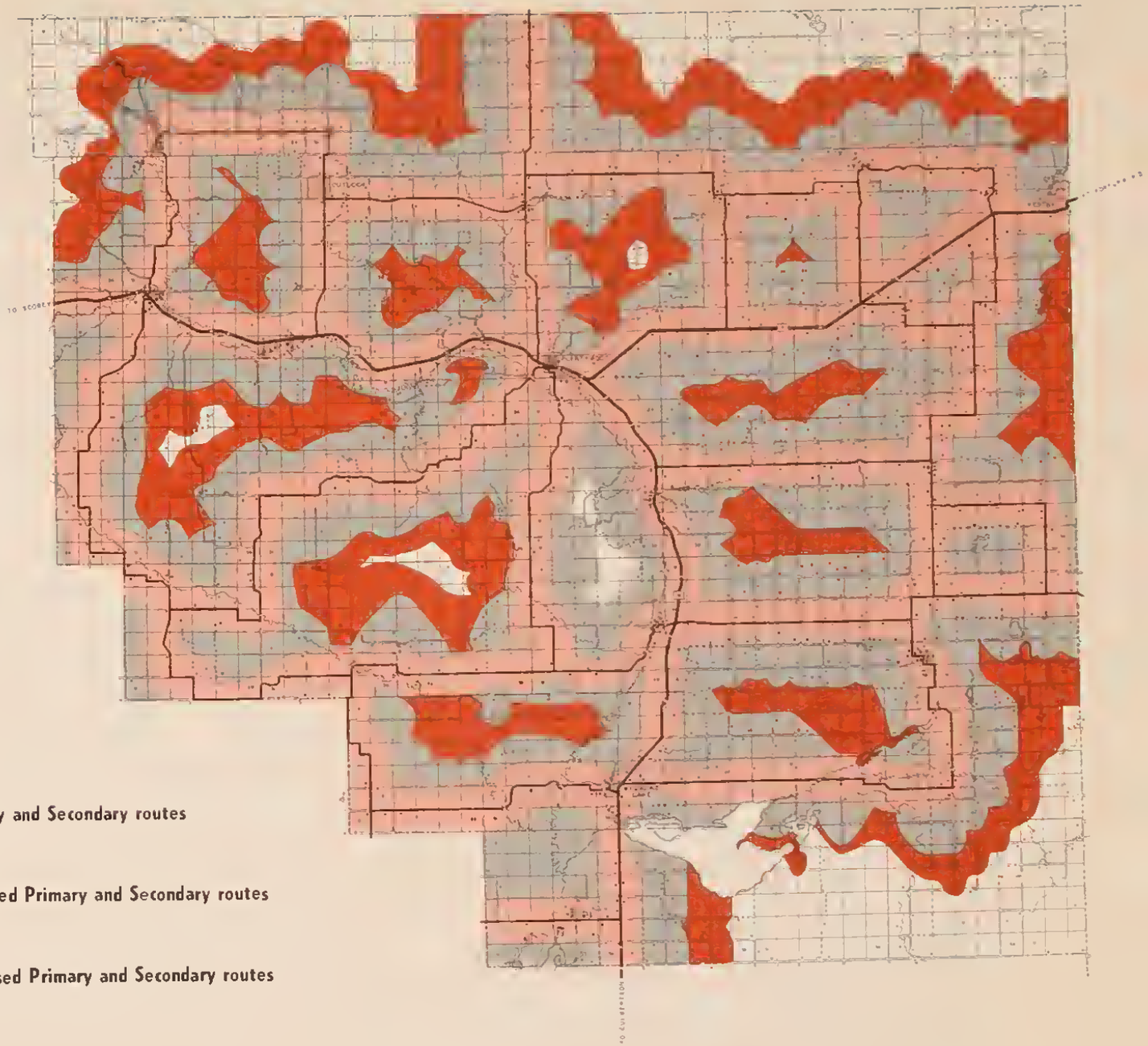
CASCADE COUNTY

SERVICE PROVIDED BY PROPOSED PRIMARY AND SECONDARY ROAD SYSTEMS

These maps shaw the relatianship af the prapased Primary and Secondary Systems ta rural dwellings in Cascade and Sheridon Counties.

In Sheridan County there are 967 farm hames and ather year-raund dwellings within ane mile af the praposed systems; a tatal af 1,310 within three and 1,477 within five miles. Only 87 rural dwellings are mare than five miles from rautes af the cambined Primary and Secandary Systems.

In Cascade Caunty 3,204 dwellings are within ane mile; 3,558 are within three miles; 3,713 are within five miles and 145 are mare than five miles from routes af the cambined Primary and Secandary Systems.



Area within one mile of proposed Primary and Secondary routes

Area within one to three miles of proposed Primary and Secondary routes

Area within three to five miles of proposed Primary and Secondary routes

SHERIDAN COUNTY

residents. The table below shows a comparison of the distance of rural residences from improved roads in 1950, and the corresponding distance after improvement of the two systems as described later.

PROXIMITY OF RURAL RESIDENCES TO IMPROVED ROADS

Distance from Improved Road (Miles)	*Percent of Rural Residences In 1950*	*After Improvement*
0.0 to 0.9	32	82
1.0 to 4.9	24	15
5.0 or more	44	3
	100	100

(Data for 1950 are from reports of the U. S. Bureau of the Census.)

While the percentage distribution of dwellings in relation to distance from improved roads after system development is based on examination of a limited number of counties, they are considered representative of conditions for the state as a whole.

Municipal Classification Plan

Based upon the criteria discussed earlier in this chapter, city streets were grouped in this study into three systems:

(a) Urban extensions of the Rural Primary System

(b) Arterial streets of community interest

(c) Local streets providing access to residences and business establishments.

Streets classed as urban extensions of the Primary System and as arterials were selected by state and city officials in cooperation with Foundation engineering staff. Since most Montana municipalities under 5,000 population do not have engineers, county officials assisted in selection of city arterials in those places.

Urban Extensians of Primary System

Statewide traffic service is not limited to just the rural Primary System. Service given by that system extends into and through the municipalities it interconnects. Even though urban extensions may carry a considerable amount of local traffic generated within the community, the state's interest from the standpoint of through traffic movements is of predominant importance.

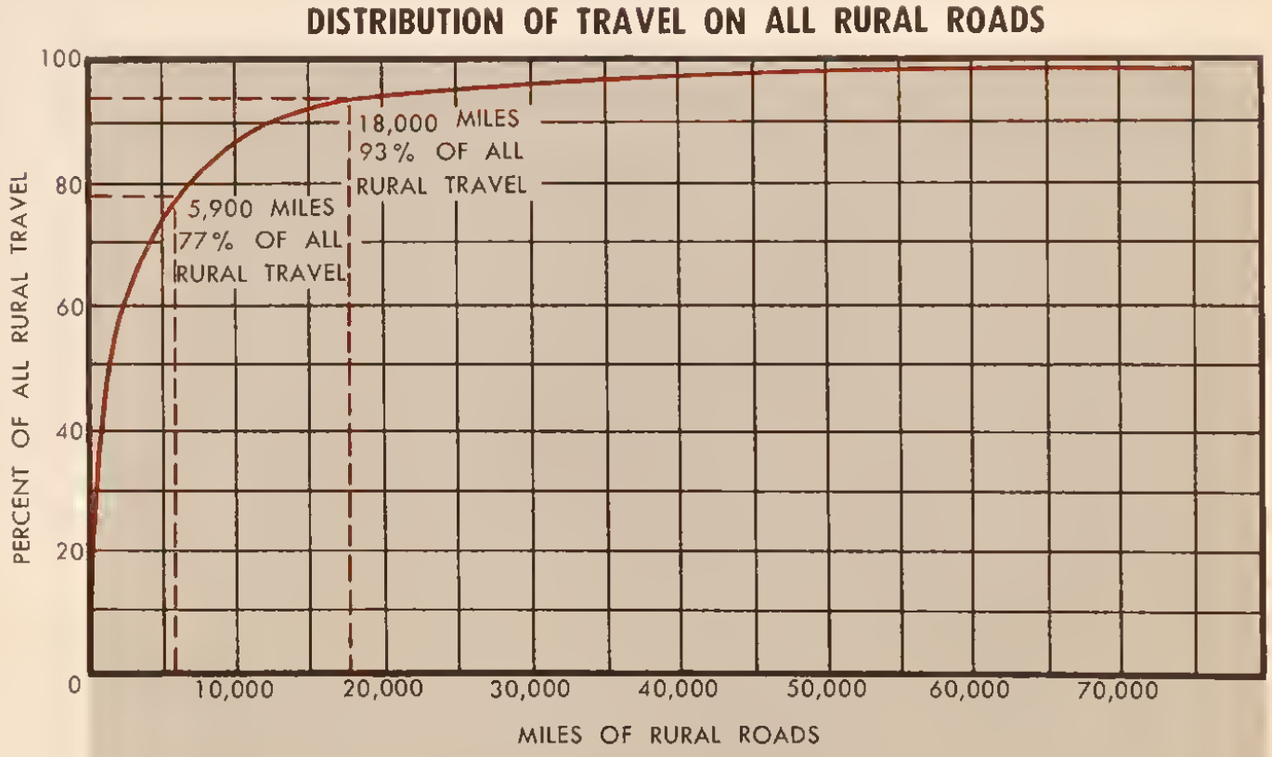
The proposed urban extensions of the rural Primary System total 167 miles in length. Of this mileage, 79 miles are in the 13 cities of over 5,000 population; 88 miles are in municipalities with less than 5,000 population.

To insure development consistent with traffic needs, through and local, the state should accept complete responsibility for the urban extensions of the rural Primary System. Such responsibility should be related to a firm financial policy established by the legislature.

Arterial Streets

The proposed arterial street systems in all municipalities total 209 miles in length. Of this mileage, 143 miles are in cities over 5,000 population; 66 miles in places of less than 5.000 population. The mileage in places of less than 5,000 population consists almost entirely of extensions of the rural Secondary System into and through cities. The mileage in cities of over 5,000 population includes in addition to urban extensions of rural Secondary routes, streets meeting the community interest criteria previously discussed.

Arterial streets are of primary interest to the community served and as such should be a municipal responsibility for improvement and



THE STUDY CLASSIFICATION PLAN FOR BILLINGS

Proposed State Highways are shown in black and proposed arterial streets in red. The remaining streets (in white) are primarily of local interest, providing access to residences and business establishments.

maintenance. However, since arterial streets are of community interest, as distinguished from local streets, a separate financial plan should be established for their development. Regardless of whether the legislature determines to provide state financial aid in development of arterial streets, it is important that provisions be made for designation of arterial streets in each municipality. For effective operations, the arterial street systems should be integrated with the urban extensions of the Primary System.

Local Streets

Exclusive of the urban extensions of the Primary System and arterial streets there are about 1,275 miles of city streets which are of only local interest, primarily providing access to residences and business establishments. Such streets are now and should remain a municipal responsibility.

How the municipal street classification principles apply is illustrated by the map of Billings on page 33.

RECOMMENDATIONS

The classification plan developed for this engineering study provides a simple, comprehensive readjustment of responsibility permitting well defined and coordinated management. To be effective it must be firmly related with an equitable finance plan.

It is recommended that the legislature:

1. Authorize a State Highway System, limited to 6,250 miles including urban extensions and circumferential routes. The figure exceeds by 153 miles the total selected for the State Highway System. The additional mileage allows for new area developments and necessary adjustments. Such action should define authority and responsibility with respect to urban extensions and should establish a financial policy to insure a balanced development between rural and urban portions of the system. Designation of routes to comprise the system should be clearly delegated to the State Highway Commission. The system should conform to the primary routes of statewide interest shown on the map on page 28.
2. Establish a Secondary Road System totaling approximately 12,500 miles. The figure exceeds by 400 miles the total selected for the Secondary Road System. The additional mileage allows for new area developments and necessary adjustments. Because it is essential that this system be integrated with the State Highway System, adequate provisions should be made to insure cooperation between the counties and the State Highway Commission. The initial selection of Secondary System routes should be by the counties using the principles established by this study, with responsibility for review and approval delegated to the Highway Commission. Management responsibility should be assigned to the counties as rapidly as possible. To insure orderly development the management plan must be coupled with an adequate financial plan.
3. Require creation of arterial street systems in municipalities, integrated with urban extensions of State Highway routes. Initial selection of arterial street systems should be made by the cities with authority for review and approval by the Highway Commission. The commission should establish criteria upon which the selections are to be made consistent with the principles established by this study. Management responsibility for arterial streets should be assigned to cities. Provision should be made for a separate financial plan consistent with the character of usage and community benefits of this class of streets.

Chapter 3

management

HIGHWAY MANAGEMENT is controlled by the basic policies established by the legislature. Inadequate and inconsistent legislative provisions are a handicap to good management. To carry out the recommended long range road and street programs efficiently and economically will require the highest level of engineering and administrative leadership. Expansion in existing organization and revised management practices along with legislative and fiscal changes will be necessary.

Some of the basic legislative changes needed have been outlined in the preceding chapter covering the recommended classification plan for road and street systems. In this chapter further needed changes affecting management, both administrative and legislative, are discussed.

This engineering study has been concerned primarily with a factual appraisal of the actual and relative engineering needs on all road and street systems to provide safe and efficient facilities for motor vehicle travel. In the course of this engineering appraisal, however, highway laws have been reviewed sufficiently to determine that a complete study and examination is needed.

NEED FOR LEGISLATIVE REVISIONS

Existing highway law consists of numerous measures enacted over a long period of years. Much of the law is outmoded in the light of modern highway transportation requirements. There are many cases of seeming conflicts, ambiguities and omissions. In some cases, outmoded law seriously handicaps efficient highway management, in other cases it is merely confusing and unnecessary.

An example of outmoded law which handicaps efficient administration is found in Sec. 16-2009—Single Purpose — and Article XIII, Sec. 5, of the Constitution. These place a limitation of $10,000 on county commissioners in incurring indebtedness or liability for a single purpose without approval by the voters. This requirement stems from conditions existing many years ago, long before motor vehicles became essential to the economy, and is unrealistic today.

Many types of modern road building and

Good highway management is dependent in the first instance on establishment of basic policy by the Legislature.

maintenance equipment cost more than $10,000 per unit. Within the limitations of broad requirements established by the legislature and of annual budgets, Boards of County Commissioners should be able to purchase equipment, let contracts and incur indebtedness without additional restrictions and without being forced to subterfuge or questionable legal actions.

Other examples of laws containing unrealistic restrictions are Sec. 32-303 and Sec. 32-306. These limit salaries of county surveyors to $3,600 per year and pay of road supervisors to six dollars per day. Instead of attempting to hire road supervisors under that title, counties hire "foremen" or "superintendents" at prevailing wages, which are much higher than the six dollar limitation, to perform the duties prescribed by law for road supervisors.

Sections 32-901 through 32-905 place restrictions and conditions on bids for corrugated iron culverts and provide penalties for failing to comply with requirements and for furnishing inferior products. This is not a proper subject for legislation. It is a matter of construction specifications and, as such, should come under administrative jurisdiction rather than law. There is no similar legislation pertaining to other kinds of highway building materials such as concrete pipe, timber, structural steel, cement, bituminous materials, reinforcing steel, aggregates, sand, steel guard rails, etc.

Sections 32-2001 through 32-2010—Controlled Access Highways — limit application of the controlled access principle of highway design to routes of the National System of Interstate and Defense Highways.

The safety, efficiency and mobility of motor vehicle operation depend greatly upon limitation of interference from the roadside and from traffic entering, leaving, or crossing at intersecting roads and streets. Many recent studies show the value of controlling access as a means of eliminating accidents, providing maximum freedom of movement, improving property values, and preserving costly investments.

The present controlled access legislation should be broadened to permit its application to other State Highway routes wherever determined necessary by the State Highway Commission for the safety and convenience of traffic.

These are only a few examples which indicate that a review of existing statutes pertaining to Montana's highways is needed. There are numerous other cases.

In the interest of facilitating improvement in road and street management the legislature should direct a comprehensive review of all existing Montana highway law. This should be done by a committee composed of state, county and municipal highway administrators, representatives of road user organizations and others experienced in modern highway law. The committee should examine the adequacy and necessity of present statutes and recommend needed and desirable changes to the legislature.

Many changes and additions will be necessary to implement the recommendations of this engineering analysis and the concurrent fiscal study. Those changes and additions should be made, within the existing framework of law, as rapidly as possible to permit start on the long range needs programs for the various road and street systems.

The guiding principles of the recommended comprehensive law study should be to provide an effective working relationship with the highway official. Resulting legislation should define jurisdictional responsibilities for road and street systems, establish an equitable finance plan re-

flecting the degree of state interest in each system, grant broad latitude and authority to the state, county and municipal authorities responsible for management of the various systems, and require accurate reporting and accounting of progress made in achieving the goals established by the legislature.

STATE HIGHWAY MANAGEMENT

Over-all management of State Highways is vested in a five member commission appointed by the governor for four-year staggered terms. The commission appoints the State Highway Engineer to serve at its pleasure. Because the commission is a part-time body the State Highway Engineer, in effect, acts both as chief administrative officer and chief engineering officer.

The commission form of management of State Highways is followed in 32 states. It is an effective form where the commission is small and appointed for staggered terms, as in Montana. The overlapping terms tend to insure continuity of policy and adherence to established courses of action until new members become acquainted with management problems. The small size tends to eliminate internal conflict and undue delays in formulation of policies and management decisions.

The State Highway Engineer directly supervises all the many engineering functions and business activities of the department. He also devotes considerable time to receiving delegations and handling public relations. The department's current organization chart indicates that no less than 10 division heads and key officials report directly to the State Highway Engineer. Under this arrangement, the State Highway Engineer now has far more to do than should be expected of one man. While considerable routine detail has been delegated to subordinates, there is need for additional effort in this direction.

A detailed examination of the various work functions of the department and the present organizational structure has not been attempted in this study. It is the intent here to discuss only revisions in engineering organization and functions which will need increased emphasis under a greatly expanded work program.

The present operations and activities of the department logically fall into two broad categories — engineering and business operations. It is recommended that the work functions be so segregated and delegated to two principal assistants — one a Deputy State Highway Engineer, the other a Business Manager. This would provide a broader top administrative organization and spread the great burden of detailed work now directly carried by the State Highway Engineer, thereby permitting him sufficient time for over-all administration, control, planning, and broad coordination of those activities delegated to the principal assistants.

Engineering Division

The proposed Deputy State Highway Engineer should have direct responsibility for all engineering functions. He should have the authority, under broad policy assignments, to act for the State Highway Engineer on engineering matters related to location, design, construction, maintenance, planning, programming, testing, research and traffic operations both in the headquarters office and in the field divisions.

Each major engineering work function, as listed above, should be assigned to staff engineers directly reporting to the Deputy State Highway Engineer.

Business Management

The non-engineering activities of the department should be under the immediate supervision of a Business Manager. Those activities include personnel, purchasing, fund and cost accounting, property management, right of way acquisition, legal services, housekeeping services, public information and related matters.

The Business Manager should have full authority to act for the State Highway Engineer in routine affairs and a sufficient staff to properly carry out all work functions delegated to him.

Internal Departmental Organization

There are no hard and fast rules applicable to organization. Within the framework of the two proposed principal assistants to the State Highway Engineer, operating under proper delegations of authority, there is much room for variation in detail and still achieve effective results. In fact, in an organization as large as the State Highway Department, organizational adjustments to meet changing conditions should be a continuing process. A small organization-and-management unit reporting directly to the State Highway Engineer should be created to study operations, methods, procedures and work functions and recommend needed changes. The essential requirements are clear-cut channels of authority and well-defined responsibilities for each staff position, together with proper balance and coordination between work functions.

Field Organization

The existing field organization of the department consists of 11 construction divisions and 11 maintenance divisions. Three different staff members of the central offices exercise direct control, at present, over the construction divisions, while the maintenance divisions are under the direct control of the State Maintenance Engineer. Field shop and office personnel are supervised by the maintenance divisions so that the construction divisions have no direct authority in obtaining the services of such personnel.

This present form of field organization is bad from a public relations viewpoint because there

is no one person who represents the Highway Department in a particular area. Consequently, many problems which otherwise could be handled in the field are taken to headquarters for an answer.

It is recommended that all department field activities, including maintenance, in a given area be placed under one head — a Division Engineer. He should have assistants for staff functions as required and, in effect, would be directing a miniature or prototype highway department. He would contact the central office on engineering matters through the Deputy State Highway Engineer and on business operations through the Business Manager. In turn, he would be contacted by the central office through the same channels so that he would have only one immediate superior in each of the two broad functional areas. In short, the Division Engineer and his organization would do the field work and the central office would be concerned only with the broad aspects of the program rather than with details.

An operation of this kind presupposes a considerable amount of decentralization. Location and design functions should be properly allocated between the central office and the proposed division engineering staffs. Design standards and policies should be decided by the central office before projects are authorized in accordance with advance planning schedules. A preliminary location report should be developed by the Division Engineer and reviewed in headquarters prior to final location and plan development. Field changes in contracts as construction progresses should be authorized under clear-cut delegations of authority as to limitations deemed administratively advisable.

Adoption of the recommended field organization plan would, over a period of time, permit

A vast amount of planning, engineering and administrative work is necessary before construction operations can be started. Decentralization of engineering activities and greater responsibility in division offices are recommended.

a substantial reduction in the number of field divisions. Of the states adjacent to Montana, Idaho has six field divisions, North Dakota has seven, and South Dakota and Wyoming have five each. From six to eight field divisions would seem to be a desirable range for Montana.

Program Planning

To permit scheduling of surveys, plan preparation and right of way acquisition well in advance of construction, an important operation that should be given emphasis within the Department is advance program planning.

Construction programs should be developed at least five years in advance and reviewed annually to keep a program for that period constantly ahead and to make adjustments required as may be necessary to meet changed conditions.

Such advanced planning permits full coordination of all functions, saves time and money, and eliminates confusion. Each division and section knows what its job is for a long period ahead and can schedule its workload efficiently and to best advantage. Advance engineering personnel requirements can be determined more precisely and personnel most effectively assigned. The process of advance program planning serves also as a continuous means of evaluating progress in relation to needs.

Many improvements in programming techniques have been developed in recent years by various highway departments. Others are bound to occur. Fundamentally, full use should be made of all available basic traffic, inventory, condition and related data which will give logical priority to the scheduling of improvements. The project work sheets of this study are the basis for initial development of advance construction programs.

State Aid Division

The enlarged road and street programs recommended by this study will be carried out by 180 public highway agencies — the State Highway Commission, 56 counties and 123 municipalities. Effective statewide coordination of the management and engineering activities of those agencies will be necessary to avoid confusion and to insure logical and properly integrated progress in the years ahead. The State Highway Commission, as the principal highway authority of the state, is the logical agency to coordinate highway administration on a statewide basis. This activity will require addition of a third major division to the department's organization — a Division of State Aid.

Primarily the work of this new division would be to coordinate and assist county and municipal highway agencies in administration of the Secondary Road System and Arterial Street System recommended in Chapter 2. The State Aid Division would be responsible to the State Highway Engineer for supervision of state-aid funds allotted to local governmental agencies, to the extent determined by the legislature and subject to such broad policies and requirements as the legislature may direct.

Principal elements of the proposed plan are:

1. Counties and cities should be directed by the legislature to designate systems as described in the Classification Chapter. These selected systems should be subject to approval by the State Highway Engineer.

2. Appropriate construction standards should be jointly developed by the counties, and similarly by the cities, in cooperation with the State Aid Division which will govern future construction improvements financed with state-aid funds.

3. Annual improvement programs should be developed by each county and each city listing projects where state-aid funds are to be utilized. These programs should have approval of the State Highway Engineer prior to final adoption.

4. Construction plans for projects financed with state-aid funds should be submitted for review and approval by the State Aid Division as to engineering features and conformity with standards before work is started.

5. Counties and cities should be required to prepare and submit annual reports of all expenditures of state-aid funds. These reports should be in the form prescribed by the state-aid unit and should show the location and purpose of such expenditures. To insure uniformity in fund and cost accounting, procedures should be developed by the State Aid Division cooperatively with the counties and with the cities.

6. Annual financial reports on county and city expenditures of state-aid funds should be analyzed, and published by the State Highway Commission, on a biennial basis for legislative and public use.

7. The state-aid unit should be authorized to provide technical assistance and advice to counties and cities on special problems of road and street location, design, construction and maintenance. In addition, provision should be made for physical testing of construction materials for counties and cities by the department's testing laboratory on an actual cost basis.

A specific portion of state-aid funds allotted to counties should be earmarked for engineering and administration including fund and cost accounting, and maintenance of records showing

AVERAGE LENGTH OF SERVICE
OF TECHNICAL EMPLOYEES
MONTANA STATE HIGHWAY COMMISSION
APRIL, 1956

Salary Classification	*Number of Employees*	*Average Service In Years*
P-9	1	34.0
P-8	1	18.0
P-7	6	26.1
P-6	13	22.5
P-5	23	23.4
P-4	12	21.9
P-3	24	17.0
P-2	55	9.8
P-1	84	7.7
TOTAL	219	13.2
SP-5	5	14.6
SP-4	11	9.8
SP-3	102	5.4
SP-2	173	2.2
TOTAL	291	3.8

AGE DISTRIBUTION OF TECHNICAL EMPLOYEES
MONTANA STATE HIGHWAY COMMISSION
APRIL, 1956

Salary Classification	AGE IN YEARS											*Total Number of Employees*
	25 or less	*26-30*	*31-35*	*36-40*	*41-45*	*46-50*	*51-55*	*56-60*	*61-65*	*66-70*	*Over 70*	
P-9										1		1
P-8					1							1
P-7						1	2	2	1			6
P-6				1	2	2	3	5				13
P-5				1	3	4	9	2	3		1	23
P-4			1		3	3	1	1		3		12
P-3		1	5	2	2	8	2	2	1	1		24
P-2	1	10	15	9	7	5	7			1		55
P-1	2	24	26	10	9	6	1	3	3			84
TOTAL	3	35	47	23	27	29	25	15	8	6	1	219
SP-5			2	1	1			1				5
SP-4		1	2	3	1		1	1		2		11
SP-3	18	31	22	10	6	3	3	4	4		1	102
SP-2	88	33	15	12	9	5	2	4	3	1	1	173
TOTAL	106	65	41	26	17	8	6	10	7	3	2	291

status and condition of roads and streets included in the Secondary Road System.

Personnel

Total departmental employees number approximately 1,500; of these, about half are assigned to the 11 field maintenance divisions, 28 percent to the field construction divisions, and 22 percent to the central office staff in Helena. Technical employees number 510, of which 219 are in engineering classifications and 291 are technicians in sub-professional grades. Of the employees classified as engineers, only 30 percent are registered; more than 60 percent are neither civil engineering graduates nor registered. The number of engineering-aides normally increases by about 200 during the construction season.

The personnel problem in Montana, as in most states, is largely in connection with engineers. The department is short-handed now from this standpoint — but not seriously so. However, to handle the known expanded construction program will require an estimated 50 percent increase in the number of technical employees within three years.

With respect to age and length of service of its technical employees, Montana is in a relatively good position in comparison with highway departments of many other states. Only 15 of the employees in engineering classifications are over 60 years of age. Even in the higher professional grades, P-5 and above, less than one-third of the engineers are over 55 years of age. It appears that retirements because of age will not be a problem for many years. The average length of service for all employees in the P-3 and higher classifications is over 20 years. The average for field division construction and maintenance engi-

COMPARISON OF SALARIES FOR SELECTED ENGINEERING POSITIONS

	Minimum Annual Entrance Salary Montana State Highway Commission	Recommended Annual Minimum of the American Association of State Highway Officials
State Highway Engineer	$10,000	$17,000
Assistant State Highway Engineer	8,825	12,000
Construction Engineer	8,508	10,000
Maintenance Engineer	8,508	10,000
Division Engineer	6,720	10,000
Materials Engineer	7,308	8,000
Assistant Staff Engineer	6,180	6,800
Resident Engineer	5,880	6,800
Senior Inspector	4,680	4,800

neers is over 23 years. For both professional and sub-professional employees, the average length of service increases gradually from the lower to higher grades, which indicates technical employees are moved along when they have acquired the necessary qualifications and experience for assignment to higher classification.

Salaries and Benefits

Although salaries of technical employees compare favorably with those of highway departments in adjoining states, they are below average for all state highway departments and, particularly in the higher grades, are considerably less than the minimums recommended by the American Association of State Highway Officials. This has come about because entrance salaries of the lower grades have been increased substantially in recent years in attempt to recruit new engineers while salaries in the higher classifications have been raised only slightly.

The present retirement plan is quite liberal for career employees. This has undoubtedly been a contributing factor to the high average length of service in engineering classifications.

Nationwide, there is a critical shortage of experienced highway engineers. The greatly enlarged national highway program recently authorized by Congress will require increases in the engineering staffs of all highway departments. The competition for available engineers, and to attract new engineers into the highway field, will require a general raising of salaries in all states. In states where present scales are below national averages, the percentage of increase necessary to meet competition naturally will be greatest. Montana is in this group. Undoubtedly it will be faced with the problem of increasing engineering salaries in the rather immediate future — not only to meet competition for available engineers but to hold present employees.

Recruitment

Engineering recruitment in Montana has been largely on a catch-as-catch-can basis with individual central office and field staff engineers partly responsible for their own requirements. In the past, there has been little organized effort to recruit new civil engineering graduates direct from colleges and universities either within or outside the state. In the past five years, only five new engineer graduates have been hired. Of these, two are still with the state and two are on military leave. Recently a start has been made on development of a three-year training program to attract new engineering graduates. This is a step in the right direction and deserves vigorous support.

Every effort should be made to work cooperatively with the Civil Engineering Department of the State College in developing interest and competence in highway engineering. Qualified State Highway Department personnel should participate in seminars covering all phases of the highway engineering field. A program of continuing research, designed to create interest among undergraduates and graduates in highway engineering, should be undertaken.

Efficient Use of Engineers

With highway engineers in such short supply, greater emphasis should be placed on making their work as effective as possible. Engineers should be relieved of all non-professional duties. Routine technical detail should be assigned to sub-professional employees.

Increased productivity will result from use of new technological developments in the fields of electronics and photogrammetry. The department has been making limited use of aerial photography in the determination of field locations. Activities in this direction should be increased and extended to cover plan development.

Housing

The department's central office in Helena is now handicapped by being quartered in several different locations. Space is at a premium in the State Highway Department headquarters building. Most division offices are housed in inadequate quarters. For economy and efficiency of operations, housing should be in keeping with the functions and organization required for the greatly expanded workload in the years ahead.

Secondary roads in Carbon and Powder River Counties. For efficient and economical use of highway funds, counties should be required to place management functions in the hands of full time registered engineers or qualified road superintendents

Every step should be taken to insure early completion of the proposed addition to the headquarters office in Helena and to provide adequate quarters for the field divisions.

COUNTY ROAD MANAGEMENT

The classification plan recommended in Chapter 2 proposes grouping of all county roads into two systems: a Secondary Road system of community interest roads totalling approximately 12,100 miles, and a Local Road System comprising the remaining roads of county responsibility. The classification plan recommends placing complete responsibility with the counties for development and maintenance of the proposed Secondary Road System. Need is stressed for a state-aid finance plan reflecting the degree of state interest in secondary roads as may be determined by the legislature.

Specific recommendations on the character and extent of state-aid for secondary roads which would be justified and feasible is a matter for consideration by the separate concurrent fiscal study. Since the entire Federal-aid Secondary System is incorporated in the proposed Secondary Road System, the finance plan must, of necessity, include current and future allotments to Montana of Federal-aid Secondary Funds. In addition, it would appear reasonable to presume that the present level of state support in matching of Federal-aid Secondary funds for construction purposes would be continued as a minimum.

The recommendation to place responsibility for construction of the Secondary Road System in the hands of the counties, coupled with an equitable state-aid finance plan, is premised upon the following factors:

1. The roads comprising the system in each county are primarily of community interest to residents of the county. Under county

administration, development of the system and the order of scheduling improvements will more closely reflect desires of local people.

2. Under the present method of operation there is a decided tendency for the state to design and construct Federal-aid Secondary projects to higher standards than would prevail under county responsibility for construction. This is logical under the present method of operation because state personnel are mainly concerned in development of State Highways. Their thinking is geared to primary road standards and this thinking is naturally reflected in secondary road design. Experience in other states has demonstrated that a satisfactory level of traffic service on secondary roads can be provided under direct county administration at lower construction standards than those now generally used in Montana. Thus, county responsibility for design and construction of the proposed Secondary Road System would result in a saving in construction costs and a more rapid rate of system development for the same total investment.
3. Under the greatly expanded Federal-aid highway program recently enacted by Congress, the workload of the State Highway Department will be more than doubled in the next three years to take up Federal-aid funds available for construction on State Highways alone. Furthermore, to carry out the long range development plans discussed later for the proposed State Highway System will place a still greater burden on department forces. The department's primary interest will be, as it has been in the past, in the problems of State Highway development. Secondary roads would logically receive lowest priority under a continuation of the present arrangement of state responsibility for construction on the Federal-aid Secondary System. Under county administration, the secondary roads would hold top priority at county level because of their character as roads of community interest.

For counties to carry out effectively the proposed Secondary Road System programs, highway administration in each county must operate at the highest possible level of efficiency to insure that the large sums of money needed will be prudently and economically spent.

Boards of County Commissioners, as now constituted, form a sound basic body for county highway administration. They are composed of three members elected for six years with staggered terms. Their small size allows decisions without unwieldy internal conflict and their tenure and staggered terms insure continuance of established policies while new members become acquainted with road problems.

Most functions of highway management are technical in nature, and, to be carried out effectively, require engineering direction. This has long been recognized in Montana, insofar as State Highways are concerned. With few exceptions, however, management of county roads is supervised directly by Boards of County Commissioners either on a county unit or district basis. The county commissioners do not, and cannot, give full-time attention to road management problems, and few have the technical training and background needed for most efficient management.

It is recommended that the legislature, as a condition of state aid for secondary roads, require the employment by each county of a full-time registered engineer or qualified road superintendent to direct all county road management functions on a county unit basis. The authority of county boards correspondingly should be limited to formulation of policies and broad administrative decisions. The recommended long-range county road program is of sufficient size in every county, even the smallest, to warrant employment of qualified technical supervisory personnel on a full-time basis. As an incentive, the legislature should earmark a specific portion of state-aid funds for engineering and administration including record keeping and fund and cost accounting. Furthermore, the legislature should establish a fixed period of time for all counties to comply with such requirements for reorganization of county road administration.

The county engineer should be appointed by the Board of County Commissioners, subject to approval by the State Highway Commission. This would insure proper administrative controls over the engineer's activities.

The proposal for appointment of a qualified engineer in each county will require repeal or modification of Sec. 32-303. Montana Statutes, relating to County Surveyor's duties in counties having a total registered vote of 15.000 and over.

Functions of county road management which should be carried out under broad legislative authority and in close cooperation with the State Highway Commission are:

1. Joint county and city cooperation in development of integrated long-range regional road and street programs
2. Operation in each county under annual improvement programs based upon facts and engineering consideration of the problems involved

3. Adoption by each county of uniform construction standards developed through joint effort of all counties
4. Maintenance of roads and bridges to uniform standards developed jointly by the various counties
5. Joint development and use by all counties of uniform fund and cost accounting procedures
6. Extension of services, upon request and at actual cost, to small municipalities covering design, construction and maintenance of streets.

The changes in county road management will of necessity come about over a period of time. Most counties do not now employ engineers and time will be required to secure competent personnel for the county engineer positions. Until individual counties are able to meet the basic management requirements, as may be established by the legislature, the State Highway Commission should be assigned responsibility for construction of the Secondary Road System to the extent that state-aid funds are available from allotments to those counties. The legislature should establish a maximum length of time for transfer to county management responsibility and should authorize suspension of state-aid funds for counties failing to accept management responsibility within the designated time limit.

MUNICIPAL STREET MANAGEMENT

Consolidation of management responsibility is a necessity in most cities to establish a solid foundation for more efficient street and traffic administration. At present, management functions are frequently scattered among a number of departments and officials. This leads to conflicts, confusion and inefficiency.

Every municipality, regardless of size, should have one qualified official responsible for coordination of all street and traffic problems. He should represent the city in all dealings with the State Highway Commission and with the Board of County Commissioners.

Basic management functions previously described for counties are also required in street administration. In addition, city street administrators must consider integration of the street system with mass transit operation, on-street and off-street parking and master plans established to control orderly and economic urban development through land-use zoning.

In the larger cities, direction of technical management functions should be under the supervision of qualified city engineers. Smaller municipalities, where street needs are relatively small and preclude the need for continuous engineering service, should be authorized to enter into agreements with Boards of County Commissioners for necessary technical services.

CONCLUSIONS

Construction and upkeep of Montana's vast road and street network involve annual expenditures running high into the millions of dollars and these expenditures will increase. Population is growing; so is the ownership and use of motor vehicles. Good management is essential to economical spending, but to have good management there must be good laws and qualified technical personnel.

Most of the laws governing Montana's road and street systems were enacted many years ago when highway and street management problems of the state and local governments were far less complex than they are today. An examination of existing statutes to determine their adequacy is in order.

To achieve the highest level of performance and to make highway and street revenues produce the greatest value possible will require continuous coordination of highway and street administration at all levels of government on a statewide basis. The State Highway Commission, as the principal highway authority of the state, is the logical agency to assume this responsibility.

Chapter 4

state highways

THE ENGINEERING APPRAISAL of State Highway routes disclosed that within the next 20 years nearly every mile of State Highway will require some type of improvement work to accommodate present and anticipated traffic.

Many improvement needs are urgently required now or in the near future. Some 67 percent of the miles needing improvement and 62 percent of the total 20-year improvement costs are for correction of deficiencies here now or those occurring within the next five years. This indicates how far present State Highway development has lagged behind requirements for safe and efficient traffic service.

The estimated total capital investment required for all State Highway improvements, rural and urban, in the next 20 years is $678 million. Of this amount $286 million is for work needed on routes of the National System of Interstate and Defense Highways; $392 million for work needed on other State Highway routes. Costs of maintenance and administration are in addition to those amounts.

The extent and urgency of needs on those two groupings of State Highways differ as later discussion shows; methods of financing also must of necessity differ because of provisions of the Federal Aid Act of 1956. For these reasons results of the engineering appraisal are discussed separately for Interstate System routes and for other State Highways in succeeding sections of this chapter.

APPRAISAL PROCEDURE

State Highways were appraised, section by section, to determine construction needs and estimated cost of bringing them to standards adequate to serve estimated 1976 traffic requirements.

Criteria and methods for appraisal of rural State Highways and extensions into and through municipalities of less than 5,000 population are described in the manual "Engineering Procedures and Instructions for Determining State Highway Needs." This manual was developed by the engineering staff with the counsel of the State Engineer Advisory Committee.

Appraisals of the portions of State Highways in cities of over 5,000 population were jointly made by state division engineers and city officials. Appraisal procedures used are contained in the manual "Engineering Procedures and Instructions for Determining Municipal Street Needs," pre-

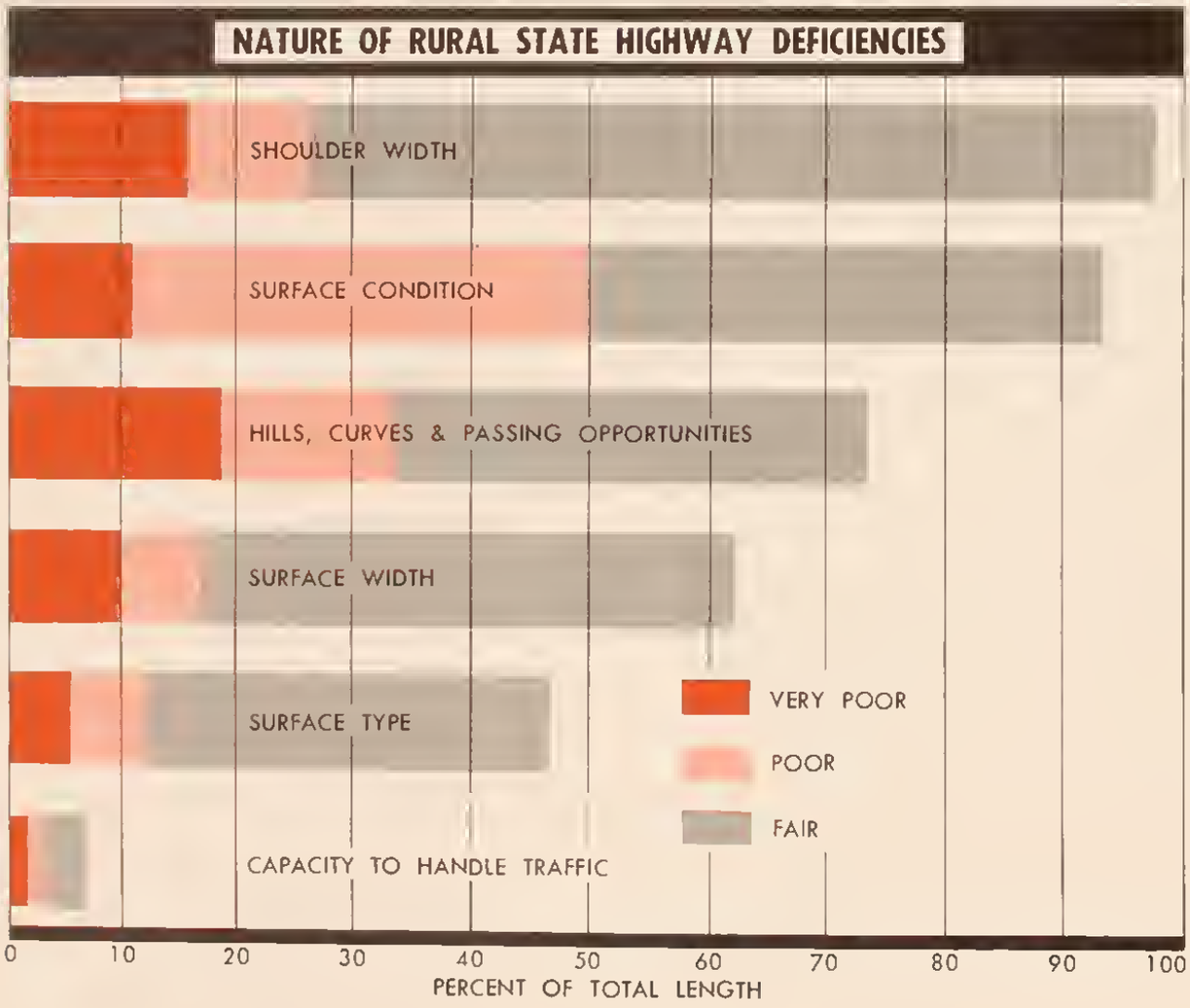
pared with the assistance of the City Engineer Advisory Committee.

Copies of both manuals can be obtained from the Fact Finding Committee on Highways, Streets and Bridges and the State Highway Commission.

Information on current physical condition of State Highway routes was obtained by engineers who inspected every mile to observe and rate structural condition of existing surfaces and roadways. Basic data pertaining to geometric features of present facilities and traffic usage were obtained from records of the Highway Planning Survey of the department.

National System of Interstate And Defense Highways

On State Highways which are a part of the National System of Interstate and Defense Highways construction needs were determined by comparison of the geometric features and physical condition of each road section with uniform design standards for Interstate routes. Needed improvements were scheduled by time periods of 1-5 years, 6-10 years, 11-15 years and 16-20 years. Guides to insure uniformity in scheduling by time periods were included in the procedural manual. The objective in the case of Interstate System routes was to bring all roadway features to design standards within a 10-year period. The guides provided for deferring some control of access features and other relatively minor features to the second 10-year period but for bringing all routes fully to the design standards within the next 20 years.



The Federal Aid Act of 1956 contemplates development of the Interstate System over a 13-year period. Despite the fact that all field work of the Interstate System appraisal, and a large part of the analysis had been completed prior to passage of the 1956 Act, the scheduling of improvements and computed program calculations were adjusted to fit the Federal-aid finance plan.

Other State Highway Routes

On State Highways not a part of the Interstate System, the method used in determining construction needs recognized that many portions of routes while, perhaps, not now developed to fully modern design standards, nevertheless are reasonably adequate to serve traffic. Since all highways cannot be brought up to design standards at the same time, the most urgent and critical situations should be dealt with first.

To insure uniformity, tolerable conditions were established which set minimum levels of geometric features and physical conditions considered reasonable for present day traffic requirements. In general, the minimum conditions called for narrower and lower type surfaces and slower driving

speeds than those required by design standards for similar terrain and traffic volumes.

Road sections not meeting the tolerable conditions are inadequate for today's traffic at the minimum level of service needed for reasonable safety and efficiency. Improvements needed on such road sections represent a backlog of deferred construction. In the study analysis, they have been handled separately from other needs.

Needed improvements to correct future deficiencies on road sections now meeting minimum conditions of tolerability were scheduled for four time periods of five years each.

Construction needs to overcome both backlog and future deficiencies were determined by use of appropriate design standards. Improvements proposed are based on obtaining maximum salvage from the existing facilities.

STANDARDS

Highway design standards are the engineering yardstick used to determine the kind and extent of improvement required for safe and economical travel under varying conditions of terrain and traffic service.

The design standards used are based on nationally accepted standards developed by the American Association of State Highway Officials, the U. S. Bureau of Public Roads, the Highway Research Board and many other agencies. Adoption and use of these standards by the State Highway Commission for development of future improvement projects will result in highways generally superior in design and service to those constructed in the past.

The two sets of design standards established for use in the appraisal of State Highways are shown in the appendix; also the table of tolerable conditions used for evaluation of road sections meeting minimum levels of geometric and physical conditions reasonable for present traffic service.

NATURE OF STATE HIGHWAY DEFICIENCIES

Lack of adequate shoulders characterize rural Montana State Highways. On only two percent of the total rural mileage are shoulder widths up to design standards. Unsatisfactory surface condition and insufficient sight distance are other predominant faults in rural areas.

In larger cities there is a limited mileage of State Highways deficient in capacity. In built-up areas of smaller cities, lack of adequate drainage and curb and gutter street sections constitute the principal deficiencies. Most of the mileage of urban State Highways has unsatisfactory surface condition. This condition prevails in cities of all population groups.

Rural State Highway Problems

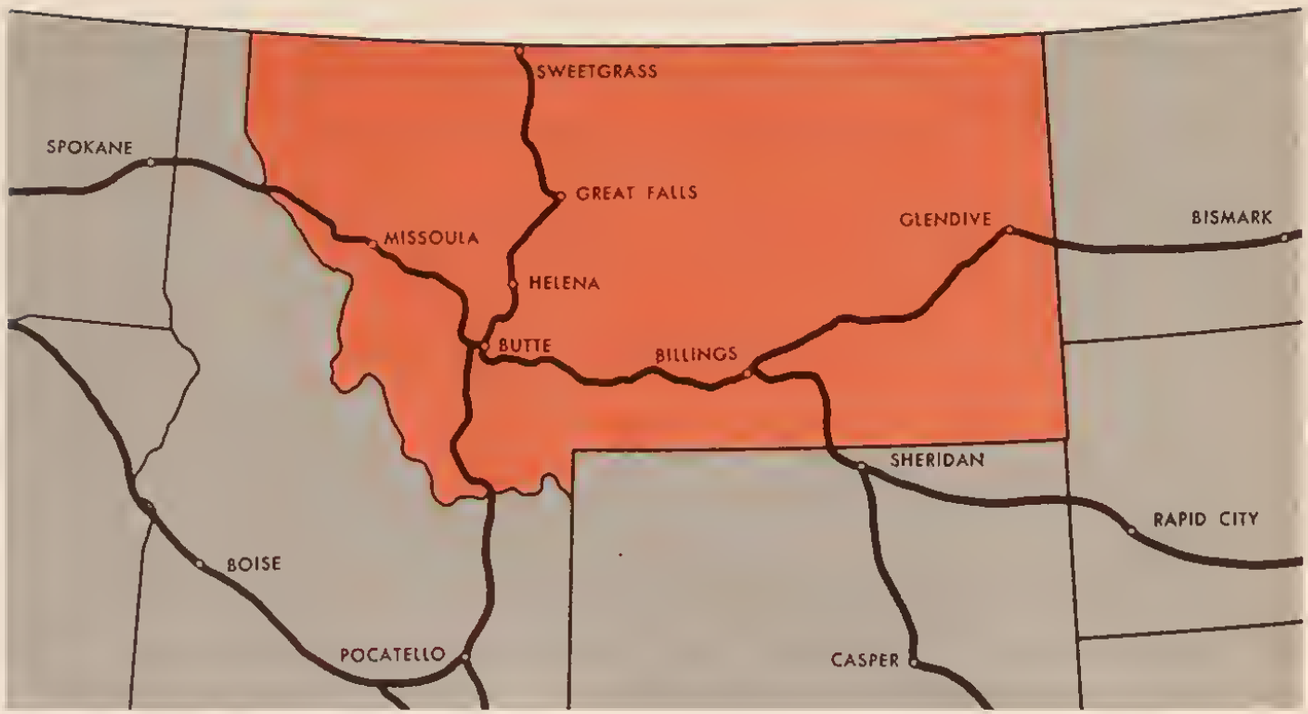
All State Highways in rural areas were rated in the appraisal as to their existing degree of adequacy to meet several different major elements of the appropriate design standards:

- 5,540 miles, 98 percent, have shoulders narrower than the widths considered desirable for the terrain and traffic volume served. On 1,580 miles shoulders are narrower than widths considered tolerable.
- 5,281 miles, 93 percent, have deficiencies in surface condition with 660 miles rated as critical and 2,233 miles as poor.
- 4,166 miles, 74 percent, fail to meet design standards for horizontal and/or vertical alignment. Sharp curves and steep grades as well as lack of sufficient sight distance to allow safe passing opportunities as often as needed are included in this category of deficiency.
- 3,494 miles, 62 percent, have surface widths narrower than called for by design standards. On 914 miles surface widths are less than tolerable conditions.
- 2,638 miles, 47 percent, are deficient in surface type. This contributes to the large mileage with deficiencies in surface condition. Low and intermediate type surfaces, by the nature of their design, cannot give satisfactory service performance under heavy volumes of traffic.
- 447 miles, six percent, have insufficient capacity to serve present and future traffic safely at the average operating speed of the design standards. On about three-fourths of this mileage, the deficiency in capacity can only be corrected by new divided multi-lane construction. On the remainder, modern two-lane construction with truck climbing lanes in some cases on steep grades would provide adequate capacity for estimated 1976 traffic.
- 960 bridges, 94 percent, have roadway widths narrower than called for by the appropriate design standard. On 408 of these bridges the roadway widths are below tolerable minimums and in 182 cases the width is less than the surface width of the approach pavements.

Modern, well designed highways with long tangents and easy curves and grades save lives, time and money.

ROUTES OF THE NATIONAL SYSTEM OF INTERSTATE AND DEFENSE HIGHWAYS IN MONTANA

Routes of the National System of Interstate and Defense Highways in Montana total 1,215 miles. The Federal Aid Highway Act of 1956 states, "It is the intent of Congress that the Interstate System be completed as nearly as practicable over a thirteen-year period and that the entire System in all the states be brought to simultaneous completion."



Narrow bridge widths are a constant threat to drivers.

- 977 bridges, 96 percent, do not fully meet standards for load carrying ability. This is not a serious deficiency in most cases. Practically all bridges built on State Highways in recent years have been designed for what engineers term an H-20 loading. Design standards generally called for H-20, S-16 loadings. The difference between these two design loadings is minor. However, on 192 bridges the rated load carrying ability is less than the tolerable conditions established for minimum traffic service.

Urban State Highway Problems

A similar rating procedure was not used for urban extensions of State Highways because of the complex nature of city traffic problems and the fact that design standards for municipal street work are more flexible than those for rural highways. Frequently it is possible to provide relief for congestion through application of traffic engineering techniques such as signalization, removal of parking or parking restrictions during peak traffic periods. Also the grid-type street development in cities permits solution to many congestion problems by use of adjacent parallel streets as one-way pairs. This avoids expensive widening construction and damage to abutting property.

Federal policy and standards adopted by the American Association of State Highway Officials call for freeway design with full control of access on Interstate System routes, except in sparsely settled rural areas.

It is not always feasible to obtain needed full freeway design on existing urban portions of Interstate routes without great damage to homes and business establishments resulting in excessive right of way costs. This study proposes all urban Interstate routes to be constructed on new locations. In most cases these locations are rural bypasses. In several of the larger cities the new

locations are through relatively undeveloped areas of those cities. Use of new locations in construction of urban Interstate System routes will relieve congestion and reduce construction needs on existing route locations and in many cases on other urban State Highways within cities served by the Interstate System.

On the 117 miles of urban extensions of State Highway routes not a part of the Interstate System, 25 miles, or 21 percent, do not now meet the minimum conditions considered tolerable for present traffic service. For the most part, this backlog of deficient mileage is due to poor structural condition of surfaces and to inadequate drainage. Only 2.5 miles are deficient now because of traffic congestion.

IMPROVEMENT NEEDS AND COSTS

The 20-year estimated cost of improvements needed on the proposed State Highway System totals $677,964,000 and includes all roadway and structure costs identified in the section-by-section appraisal, costs for subsequent resurfacing within the period and stopgap betterments necessary to keep intolerable facilities in service until such time as they can be improved to adequate standards. Of the total, $641,506,000 is for work on rural portions of the system; $36,458,000 is for work on portions of the system within cities.

National System of Interstate And Defense Highways

Total estimated cost of Interstate System improvements is $286,393,000 including $25,048,000 for right of way and control of access and $91,202,000 for 435 bridges and highway separation structures. Of the total, $271,688,000 is for improvements needed for initial development of the system in the 13-year period, 1957-1969, in accordance with the finance plan of the 1956 Federal Aid Act and $14,705,000 is for subsequent resurfacings in the period 1970-1976.

Rural Interstate Rautes

Needed work on rural portions of Interstate System routes involves a total of 1,202 miles of improvements with a total estimated cost of $275,660,000.

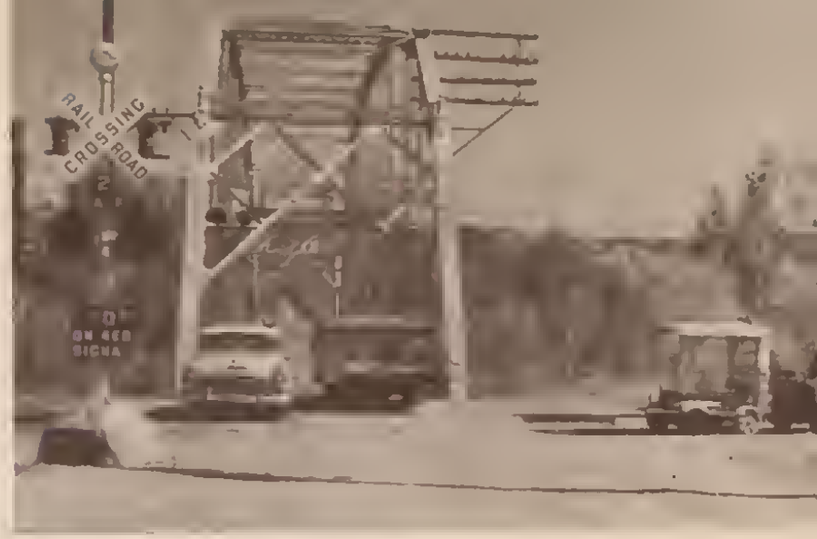
Proposed construction calls for 512 miles on completely new location and 690 miles of reconstruction on existing alignment including some resurfacing and widening. Of the mileage of existing routes being replaced by new location, 111 miles is retained in the proposed State System to provide access to cities; 309 miles is proposed for transfer to county jurisdiction. The difference is accounted for by abandonments, shortening of travel distance due to more direct alignment and rural bypasses of cities not replacing existing rural mileage.

Of the total rural mileage, 311 miles would be divided four-lane construction. On the remaining 891 miles, two-lane construction will provide adequate traffic capacity.

Municipal Interstate Rautes

Improvement needs on Interstate routes within municipalities involve 13 miles at a total estimated cost of $10,733,000. All of this mileage would be on new location with full control of access. Proposed improvements are for nine miles of divided four-lane construction and four miles of two-lane construction.

The difference between the proposed Interstate urban mileage and the present 48 miles on existing



More than 400 bridges on rural State Highways have roadway widths below the minimum considered tolerable for today's traffic. On 182 of these bridges the roadway width is less than that of the approach pavement.

locations is accounted for by rural bypasses. These occur generally around cities of less than 5,000 population where the cost of obtaining full control of access on locations within the cities is not warranted and would frequently cause severe hardship and damage to property. In most cases the existing routes through cities remain a part of the proposed State Highway System as business alternates to the new Interstate location.

20-YEAR NEEDS
PROPOSED STATE HIGHWAY SYSTEM
(Including Right of Way and Structures)

	Miles	*Cost (In Thousands)*
INTERSTATE SYSTEM ROUTES		
Rural	1,202	$275,660
Urban	13	10,733
Total	1,215	$286,393
ALL OTHER STATE HIGHWAYS		
Rural	4,721	$365,846
Urban	155	25,725
Total	4,876	$391,571
TOTAL RURAL	5,923	$641,506
TOTAL URBAN	168	36,458
TOTAL NEEDS	6,091	$677,964

Other State Highway Routes

In the next 20 years all but six miles of the proposed State Highway System, excluding Interstate System routes, will require some kind of improvement. This is because of traffic growth and because the average life of high type surfaces is about 25 years; less for intermediate types. The total estimated cost, rural and urban, of needed improvements on State Highways not a part of the Interstate System is $391,571,000. Of this amount, $137,460,000 is for improvements needed now to remedy existing intolerable conditions.

Rural Needs

Needed improvements in rural areas during the 20-year period total 4,721 miles in length with a total estimated cost of $365,846,000. This includes $7,888,000 for right of way and $92,218,000 for structures.

The engineering appraisal shows that 1,807 miles, 38 percent, are deficient now. Estimated costs of improvements needed to correct these existing deficiencies total $132,430,000. The map on page 57 shows the location of all mileage in this backlog of needed work.

More than 77 percent of the total rural cost is for improvements needed within 10 years. This would provide both for overcoming the accumulated backlog of deficiencies together with those occurring during that time period.

Proposed construction improvements include 1,343 miles on new locations, generally closely paralleling existing facilities; 2,044 miles of reconstruction on existing alignment and 1,334 of resurfacing and widenings. The proposed improvements involve 20 miles of divided four-lane construction and 4,701 miles of two-lane construction.

Municipal Needs

Inside municipalities needed construction on State Highways, excluding Interstate System routes, involves 155 miles of improvements with a total estimated cost of $25,725,000. Of this, 25 miles and $5,030,000 is for correction of existing intolerable conditions.

Improvements needed are mostly base and surface reconstruction or widenings on existing locations. Only six miles of new construction are needed. Of the total, 70 miles are in the 13 cities of over 5,000 population; 85 miles in municipalities of less than 5,000 population.

Federal-aid Primary System

The Federal Aid Act of 1956, in addition to making provisions for development of the Interstate System, provides for increased Federal funds to accelerate improvement of all other Federal-aid Systems.

All routes of the existing Federal-aid Primary System in Montana are included in the proposed State Highway System. In order to permit evaluation of the effect of this increased Federal-aid program, construction requirements on the existing Federal-aid Primary System over the next 20 years are summarized in the following table:

20-YEAR IDENTIFIED
CONSTRUCTION NEEDS
FEDERAL-AID PRIMARY SYSTEM
(Excluding Interstate Routes)
(In Thousands)

	Backlog	*1957-1976*
Rural	$130,526	$181,340
Urban	4,756	15,652
TOTAL	$135,282	$196,992
GRAND TOTAL		$332,274

The above costs do not include replacements or

allowances for stopgap construction. *They are a duplication of, and not in addition to, the needs previously discussed for State Highway routes not a part of the Interstate System.*

AVERAGE COSTS

Costs for the 311 miles of divided four-lane construction and 891 miles of two-lane construction on rural Interstate System routes average $374,500 and $166,000 per mile respectively. These costs include structures, right of way and necessary provisions for control of access.

Average costs for urban Interstate routes, with full control of access, are $975,000 per mile for divided four-lane construction, and $348,000 per mile for two-lane construction.

By type of surface, average costs per mile for rural roadway improvements on State Highways not a part of the Interstate System are:

Surface Type	*Cost Per Mile*
2 lane, Intermediate Type	$ 46,600
2 lane, High Type	52,700
4 lane, High Type	127,800

The average cost per mile for municipal State Highway improvements, excluding Interstate routes, is $95,400. The average cost in municipalities under 5,000 population is $78,100; in cities of over 5,000 population is $117,800. These costs include right of way but exclude structures.

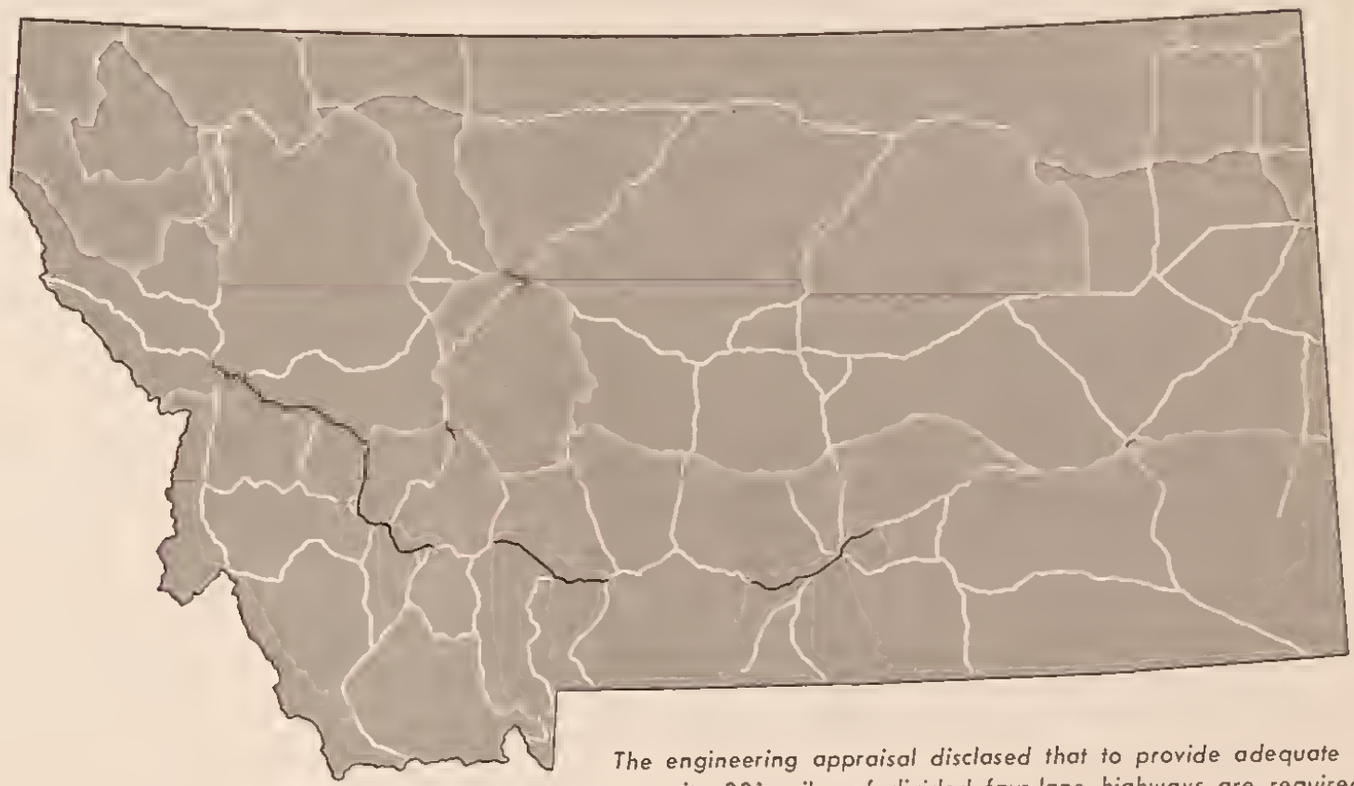
STATE HIGHWAY PROGRAMS

Four alternative programs for meeting the long range needs on the proposed State Highway System have been developed. In each case they provide for overcoming backlog deficiencies, meeting future needs as they occur and for costs of maintenance and administration of the system. The variable in the four plans is the length of time to overcome the backlog of work now existing on State Highway routes not a part of the Interstate System.

The Federal Aid Act of 1956 in establishing the 13-year construction plan for development of the Interstate System offers such advantages the state can ill afford not to provide its very low share of the cost. In Montana, the 1956 Act provides for a Federal matching ratio of 91.4 percent of the total Interstate System cost against 8.6 percent of matching state funds. For this reason the four alternative programs are identical insofar as Interstate System costs are concerned.

To catch up on the existing backlog of needs on State Highways (not included in the Interstate System) in 10 years, to meet the needs arising on those routes during that period and provide for development of the Interstate System routes will require an average annual expenditure of $62,802,000 during the first 10-year period, $39,226,000 per year during the next three years and $19,488,000 annually for the next seven years. Total cost over the 20-year period is

NEEDED RURAL DIVIDED FOUR-LANE HIGHWAYS



The engineering appraisal disclosed that to provide adequate capacity 331 miles of divided four-lane highways are required within the next 20 years on rural portions of the proposed State Highway System. Locations of needed four-lane divided highways (shown in black) are on routes of the Interstate System. Those in red are on other State Highway routes.

$882,114,000. Under this plan, annual requirements drop off at the end of 10 years and again at the end of 13 years because in the first 10-year period the backlog of deficiencies would be overcome and after 13 years initial development of the Interstate System would be accomplished. During the last seven years of the 20-year period, construction would be needed only for new requirements and for replacements. Details of the plan are shown in Table I separately, rural and urban, for the Interstate System routes and for other State Highways. Solely from an engineering standpoint, this is the shortest feasible program since a quicker catch-up period is hardly practical of accomplishment. Its feasibility from a financial standpoint must be determined from the findings and recommendations of the separate fiscal study.

If the 10-year catch-up program is not found feasible either on a pay-as-you-go or credit financing basis, then construction costs on State Highways, other than Interstate System routes, will have to be spread over a longer period of time.

Table II shows average annual program amounts based on initial development of the Interstate System in 13 years with a 13-year catch-up period for all other State Highways.

TABLE I

10-YEAR CATCH-UP PROGRAM
PROPOSED STATE HIGHWAY SYSTEM

(Based on Initial Development of Interstate System Routes in 13 years and a 10-year Backlog Catch-up Period for other State Highways)

(In Thousands)

	Average Annual Costs		
	First 10 Years	*Next 3 Years*	*Next 7 Years*
CONSTRUCTION			
INTERSTATE SYSTEM ROUTES			
Rural	$20,096	$20,096	$ 2,058
Urban	803	803	43
Total	$20,899	$20,899	$ 2,101
OTHER STATE HIGHWAYS			
Rural	$28,477	$ 8,108	$ 8,108
Urban	2,328	244	244
Total	$30,805	$ 8,352	$ 8,352
TOTAL RURAL	$48,573	$28,204	$10,166
TOTAL URBAN	3,131	1,047	287
TOTAL CONSTRUCTION	$51,704	$29,251	$10,453
MAINTENANCE AND ADMINISTRATION	$11,098	$ 9,975	$ 9,035
TOTAL ANNUAL PROGRAM COSTS	$62,802	$39,226	$19,488

TABLE II

13-YEAR CATCH-UP PROGRAM
PROPOSED STATE HIGHWAY SYSTEM

(Based on Catching Up in 13 Years and Meeting Needs as They Occur)

(In Thousands)

	Average Annual Costs	
	13-Year Period	*Next 7 Years*
CONSTRUCTION		
INTERSTATE SYSTEM ROUTES		
Rural	$20,096	$ 2,058
Urban	803	43
Total	$20,899	$ 2,101
OTHER STATE HIGHWAYS		
Rural	$24,456	$ 6,844
Urban	1,856	229
Total	$26,312	$ 7,073
TOTAL RURAL	$44,552	$ 8,902
TOTAL URBAN	2,659	272
TOTAL CONSTRUCTION	$47,211	$ 9,174
MAINTENANCE AND ADMINISTRATION	$10,872	$ 8,971
TOTAL ANNUAL PROGRAM COSTS	$58,083	$18,145

Under this plan an average annual expenditure of $58,083,000 would be required during the catch-up period of which $47,211,000 would be for construction; $10,872,000 for maintenance and administration. Average annual costs for the next seven years would be reduced to $18,145,000. The 13-year catch-up period would provide for overcoming existing and accruing deficiencies on all State Highway routes in the same period of time as the 1956 Federal Aid Act establishes for initial development of the Interstate System.

Table III shows average annual program amounts based on initial development of the Interstate System in 13 years with a 15-year catch-up period for all other State Highways. The average annual cost for the first 13 years under this arrangement is $55,987,000. Because of the lesser requirements for Interstate System construction, the average annual cost for the last two years of the catch-up period drops to $36,249,000. Under this plan, average annual costs for the last five years of the 20-year study period would be reduced to $16,353,000 since construction would consist only of new requirements and replacements.

Table IV shows average annual program amounts based on initial development of the

TABLE III

15-YEAR CATCH-UP PROGRAM
PROPOSED STATE HIGHWAY SYSTEM

(Based on Initial Development of Interstate System Routes in 13 years and a 15-year Backlog Catch-up Period for all other State Highways)

(In Thousands)

	Average Annual Costs First 13 Years	Next 2 Years
CONSTRUCTION		
INTERSTATE SYSTEM ROUTES		
Rural	$20,096	$ 2,058
Urban	803	43
Total	$20,899	$ 2,101
OTHER STATE HIGHWAYS		
Rural	$22,670	$22,670
Urban	1,645	1,645
Total	$24,315	$24,315
TOTAL RURAL	$42,766	$24,728
TOTAL URBAN	2,448	1,688
TOTAL CONSTRUCTION	$45,214	$26,416
MAINTENANCE AND ADMINISTRATION	$10,773	$ 9,833
TOTAL ANNUAL PROGRAM COSTS	$55,987	$36,249

TABLE IV

20-YEAR CATCH-UP PROGRAM
PROPOSED STATE HIGHWAY SYSTEM

(Based on Initial Development of Interstate System Routes in 13 years and a 20-year Backlog Catch-up Period for all other State Highways)

(In Thousands)

	Average Annual Costs First 13 Years	Next 7 Years
CONSTRUCTION		
INTERSTATE SYSTEM ROUTES		
Rural	$20,096	$ 2,058
Urban	803	43
Total	$20,899	$ 2,101
OTHER STATE HIGHWAYS		
Rural	$18,292	$18,292
Urban	1,286	1,286
Total	$19,578	$19,578
TOTAL RURAL	$38,388	$20,350
TOTAL URBAN	2,089	1,329
TOTAL CONSTRUCTION	$40,477	$21,679
MAINTENANCE AND ADMINISTRATION	$10,536	$ 9,596
TOTAL ANNUAL PROGRAM COSTS	$51,013	$31,275

Special maintenance operations include road and structure repairs necessitated by abnormal conditions such as floods.

Interstate System in 13 years with a 20-year catch-up period for all other State Highways. The average annual cost for the first 13 years under this plan is $51,013,000; for the next seven-year period, $31,275,000.

If either the 13, 15 or 20-year catch-up programs for State Highways, other than Interstate System routes, are adopted, some improvements needed in the first 10 years will have to be deferred. Deferment of construction when needed and spreading of the backlog work over longer periods of time means putting up with losses suffered through poor road service, accidents, delay and congestion. Under all four alternative programs the total costs for a 20-year period are the same.

Adoption of the shortest catch-up program period found feasible by the fiscal study would provide long-lasting benefits of modern highways at the earliest date.

Comparison of the various alternative State Highway System program costs with alternative programs for county road and city street systems is presented in Chapter 7.

Maintenance and Administration Costs

Annual allowances for maintenance included in the four alternate programs are based on cost experience in Montana, an analysis of maintenance practices and standards and the character of improvements needed in the 20-year study period.

Quality of present State Highway maintenance is generally good. There is, however, a gap between what is being done and what would be considered full maintenance performance. Somewhat greater emphasis is needed in such areas as mowing and related roadside operations, periodic resealing of bituminous surfaces and traffic services such as lane striping and signing. In addition, the legislature should place complete responsibility with the State Highway Commission for maintenance, including snow and ice control, for State Highways within cities. Pres-

ent practices vary from city to city. In larger cities it may be advantageous for the state to enter into contractual agreements with the cities for performance of all or part of the maintenance work.

During the last five years, total maintenance expenditures, exclusive of betterments by maintenance forces, have averaged $5.6 million annually. This is equivalent to about $930 per mile annually. Studies indicate that this average per mile cost of the last five years should be increased by about 15 percent to provide full maintenance performance on the State Highway System as it exists.

As the State Highway System is brought to adequate standards the unit maintenance cost, that is the cost per square yard of surface, shoulders, roadside, etc., will be reduced. This is attributable to the elimination of excessive maintenance now required on deficient sections. However, the increase in mileage of higher type surfaces, the wider right of way, roadway and surfaces resulting from construction of needed 20-year improvements will cause a further increase in average per mile maintenance expenditures in the future. This is particularly true for the needed mileage of divided four-lane highways where maintenance costs will be approximately double those for high type two-lane surfaces. An additional factor affecting total future maintenance requirements is the increase in State Highway System mileage to 6,250 miles as recommended in Chapter 2.

It is estimated the effect of all of those factors will result in a total average annual maintenance cost of $8.1 million over the 20-year period. This is approximately $1,300 per mile, about 20 percent greater than that estimated as needed now for full maintenance performance on existing State Highways.

Administration costs have been estimated at five percent of total construction and maintenance costs. That provides for overhead expenses for general management, personnel, research, traffic and planning and allied activities. It does not include allowance for construction of additional office quarters and other buildings which will be necessary for a stepped-up highway program.

PRIORITIES OF IMPROVEMENTS

Almost two-thirds of the total 20-year cost for improvements needed on the proposed State Highway System is for backlog work and for needs arising in the next five years. Even if sufficient money could be made available, a construction program of such magnitude could not feasibly be undertaken within a five-year period. There will be a considerable time-lag in putting a greatly accelerated improvement program under way; time required to prepare plans, acquire right of way, obtain necessary added personnel, let contracts and meet administrative problems. This time-lag and the volume of needed work makes the question of choosing projects which will be of greatest over-all benefit to the users and to the state's economic welfare a matter of paramount concern during the early years of whatever finance plan is adopted.

Basic Elements for Project Priorities

Selection of high priority projects for inclusion in annual construction programs should be based on facts and engineering consideration of the problems involved. Development of annual construction programs should not be a spur-of-the-moment process nor subject to the whims of political manipulation.

Fundamental factors influencing establishment of individual project priorities include:

- Legislative requirements for division of funds between rural and urban work and by systems
- Need for continuity in route development
- Physical condition
- Geometric features
- Volume and character of traffic
- Construction cost in relation to benefits
- Area distribution of work for most effective utilization of personnel.

All of these fundamental factors are subject to rather precise evaluation. They comprise the foundation upon which annual improvement programs, involving selection of projects of greatest urgency and benefit, can be prepared three to five years in advance of construction. Such advance programs will, of course, require periodic review and revision because of emergency needs caused by floods or other disasters, climatic conditions, technical difficulties in surveys, plan preparation, right of way acquisition and award of contracts, and the availability of materials and contracting organizations. But they will insure orderly progress and will permit scheduling of surveys and preliminary engineering work well in advance of construction.

High Priority Projects

It was not intended that this engineering study establish individual project priorities as a basis for annual construction programs and no attempt has been made to do so. However, the section-by-section appraisal procedure provides several broad priority indices which should be used by the State Highway Department for development of annual construction programs.

The individual project work sheets of this study provide flexibility in obtaining over-all summaries of cost by systems and areas to meet any basic requirements established by the legislature for fund distribution.

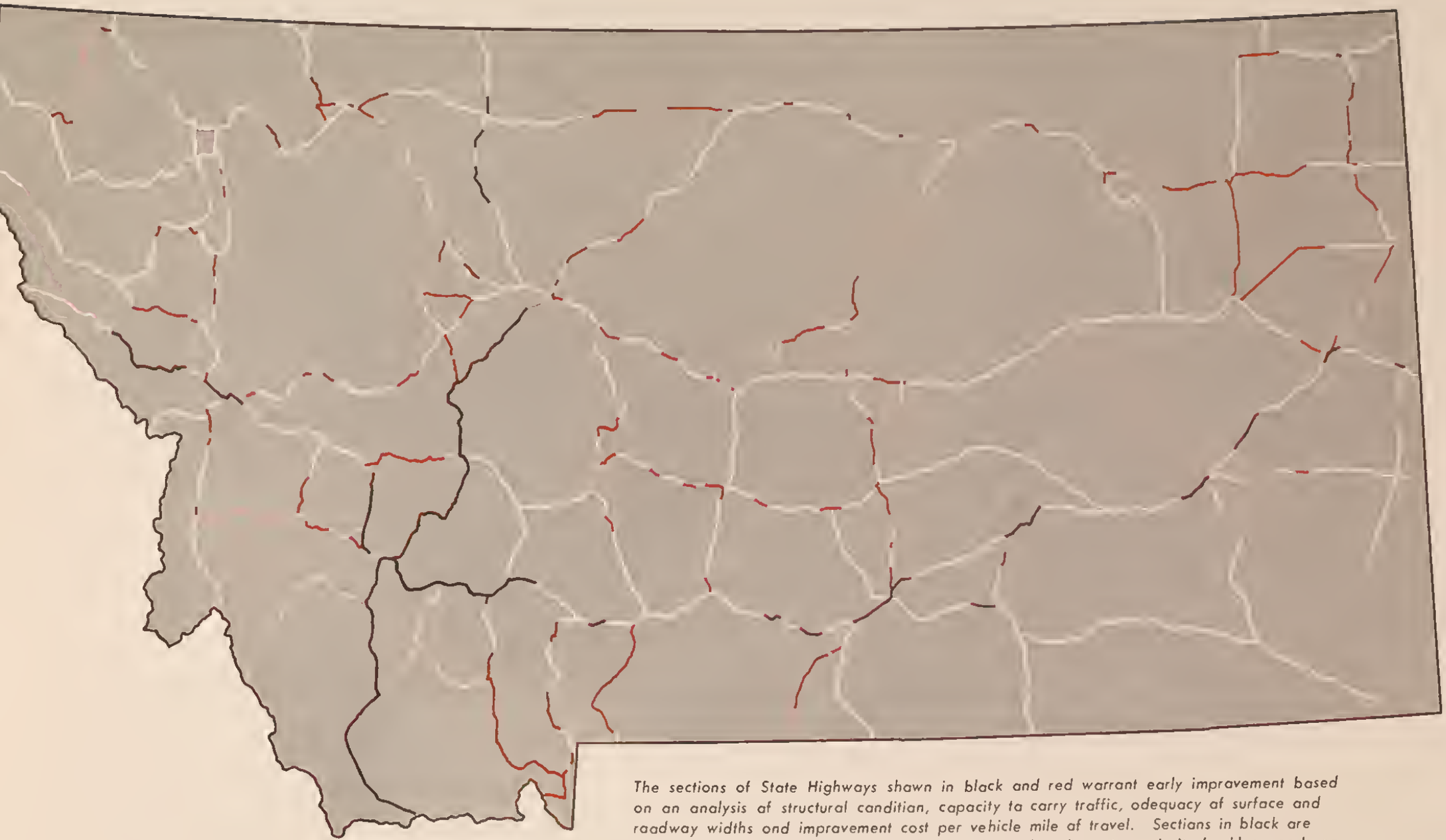
Alignment and sight distances typical of earlier construction practices today restrict free and safe movement of vehicles.

All future improvement needs were scheduled by time periods based on estimated remaining life of existing surfaces and adequacy of the present facility from the standpoint of traffic capacity. The most critical needs on routes not included in the Interstate System, those involving correction of conditions below acceptable minimum levels for reasonably adequate traffic services, were placed in a separate category of backlog work. This scheduling process in itself provides a broad priority classification.

It was recognized early in the study that the backlog needs and needs of the first five-year period would constitute such a high proportion of the total 20-year needs that additional priority breakdowns would be needed for advance planning purposes.

All backlog and first period rural projects were rated individually during the appraisal in regard to four of the basic priority elements. They include (1) structural condition, (2) capacity to carry traffic, (3) adequacy of surface and road-

HIGH PRIORITY NEEDS ON INTERSTATE SYSTEM AND OTHER STATE HIGHWAY ROUTES



The sections of State Highways shown in black and red warrant early impravement based on an analysis af structural canditian, capacity ta carry traffic, odequacy af surface and raadway widths ond impravement cost per vehicle mile af travel. Sectians in black are on rautes of the Interstate System. Sections in dark red are tap priarity backlog needs on ather State Highway rautes. Sectians in light red are the balance af the backlag needs. Estimated cast af the tap priarity needs (black and dark red) tatals $170 millian. Abaut 60 percent af that cast is for Interstate System needs and 40 percent far improvements on other Stote Highway routes.

way widths and (4) improvement cost per vehicle mile of travel. The structural condition rating reflects the ability of a road to carry traffic loads; the capacity rating reflects the ability to carry traffic safely at reasonable speeds; the rating of roadway and surface widths provides a measure of the relative safety of each road; the cost rating measures user benefits since the less expensive projects per vehicle mile of travel will provide the optimum traffic service per dollar spent for construction.

From an analysis of these ratings in various combinations, and with recognition of the need in some instances for continuity in route development, the engineering staff selected projects of top priority from rural Interstate System improvements proposed for the first five-year period and from the backlog work needed on other State Highways.

The location of the selected top priority projects is shown on the map on page 57. Also shown is the location of the backlog needs not included with the top priority group. Estimated cost of the top priority work totals $170 million, approximately one-third of the amount of work needed on rural State Highways in the first 10 years of the 20-year period. About 60 percent of that cost is for Interstate System improvements; 40 percent for improvements on other rural State Highways.

A similar rating procedure was not used for State Highway improvements within cities because of their number and the lack of a satisfactory basis for establishing the relative urgency of a particular project in a city with rural projects or projects in other cities. To the extent possible, backlog and first period improvements within cities connecting with rural top priority projects should be given early consideration.

CONCLUSIONS

The alternative programs presented in this chapter for development of the State Highway System establish an engineering base for a fiscal plan geared to current and future needs. Although average annual costs are lower by spreading the program over longer time periods, total costs remain the same. An improvement program accelerated to the greatest extent found feasible by the fiscal study should provide the benefits of a modern State Highway System at the earliest date and without added total cost to the citizens of the state.

In the interest of orderly and efficient progress, the vast amount of basic data gathered and analyzed in this study should be utilized by the State Highway Department for establishment of advance construction programs. Priority studies should be further refined and put on a continuing basis. Provision should be made for periodic re-appraisal of needs to meet changing conditions and provide a measurement of the progress being made in modernizing the State Highway System.

Chapter 5

county roads

THE ESTIMATED TOTAL COST of improvements needed during the next 20 years on the proposed Secondary Road System of 12,500 miles recommended in Chapter 2 for complete county responsibility, is $233 million. Of this amount $86 million, 37 percent, is for improvements needed now to correct backlog deficiencies.

Estimated total construction requirements for local county roads during the 20-year period are $185 million.

Total cost of all needed improvements on county roads is $418 million. This is for construction only, including stopgaps and future resurfacings. It does not include allowances for maintenance or for administration.

While total cost of county road needs may appear large, it should be borne in mind that the mileages are great and that improvements would be spread over a 20-year period. The average annual cost for all needed improvements is $960 per mile on the proposed Secondary Road System and $310 per mile for local roads.

APPRAISAL PROCEDURE

Needs of the proposed Secondary Road System in each county were determined section-by-section following a procedure similar to that used for State Highway routes not on the Interstate System. The criteria and methods of the Secondary Road System appraisal are described in the manual, "Engineering Procedures and Instructions for Determining County Road Needs" prepared with the assistance of the County Engineer Advisory Committee. Copies of this manual can be obtained from the Fact Finding Committee on Highways, Streets and Bridges and the State Highway Commission. In many counties, State Highway Department personnel assisted in the field appraisal work on the Secondary Road System because of the lack of engineering personnel at county level.

Needs on the county local roads were appraised by means of a statistical process to determine the annual cost to improve to adequate standards over a 20-year period. This analysis was made by the engineering staff based upon inventory records of the Highway Planning Survey and reports from each county on local road usage and maintenance practices.

Standards

Design standards for the proposed Secondary Road System call for dustless surfaces on all

ACCUMULATIVE CONSTRUCTION NEEDS
PROPOSED SECONDARY ROAD SYSTEM
(Including Right of Way)
(In Thousands)

Period	*Roadway*	*Structures*	*Total*
Backlog	$ 67,269	$19,182	$ 86,451
5 Years	114,391	24,568	138,959
10 Years	152,347	28,831	181,178
15 Years	183,137	30,980	214,017
20 Years	199,550	32,991	232,541

road sections estimated to serve over 100 vehicles per day in 1976. Of the proposed system, 2,634 miles, 22 percent, carry traffic in excess of 100 vehicles per day now. It is estimated that by 1976, about 44 percent, or 5,300 miles, will carry traffic in excess of 100 vehicles per day. On the remaining 6,750 miles, gravel surfaces capable of supporting year-round travel are proposed. Other elements of the Secondary Road System design standards, such as geometric features of alignment, gradients, roadway and surface widths, etc., are equal to or exceed minimum values recommended by the American Association of State Highway Officials for secondary roads.

The design standards for local county roads are based on service and area characteristics. Provision of gravel surfaces was called for as a minimum on all local roads, exclusive of trails, as a matter of economic necessity. Higher types of surfaces were called for where traffic volumes and character of service warranted. Safety and convenience were given primary consideration in establishment of surface and roadbed widths proposed for local road development.

Design standards used in the appraisal of county road needs together with the table of tolerable conditions for Secondary Roads are shown in the appendix.

PHYSICAL NEEDS ON SECONDARY ROADS

Nearly all of the proposed Secondary Road System will require some kind of improvement during the next 20 years. Needs range from gravel surfaces on adequately designed roadways to a few miles of four-lane highways with high type surface. The needed multi-lane facilities are generally short stretches of road through suburban unincorporated areas adjacent to a few of the state's larger municipalities. The total miles of each surface type proposed in the study period are:

Surface Type	*Miles*	*Percent*
Gravel	6,754	56
Bituminous Surface Treated	4,347	36
Intermediate Type	817	7
High Type, 2 lane	147	1
High Type, 4 lane	6	—
TOTAL	12,071	100

The urgency of needed improvements varies widely by counties. In a few, as much as 75 percent of the Secondary Road mileage needs improvement now or within five years; in others as little as 40 percent. On the average, 36 percent of the improvement mileage is needed to correct backlog deficiencies; a total of 61 percent is needed within five years, 81 percent in ten years and 96 percent within 15 years.

Nature of Secondary Road Deficiencies

During the field appraisal each section of the proposed Secondary Road System was rated on its adequacy to meet design standards in the following respects:

Surface type
Surface condition
Surface width
Roadway and shoulder width
Horizontal alignment
Gradients.

Similarly bridges were rated as to:

Clear roadway width
Vertical clearance
Structural condition.

Some road sections and bridges were found deficient in all elements rated. Most were deficient in one or more respects. Results of the rating process show:

- 9,478 miles, 81 percent, have deficiencies in surface condition with 1,962 miles rated as critical and 3,030 additional miles rated as poor

- 8,857 miles, 76 percent, have roadway or shoulder widths, or both, narrower than widths considered desirable for the terrain and traffic volume served. On 1,975 miles the roadway or shoulder widths are less than minimum widths established as tolerable for existing traffic
- 7,517 miles, 64 percent, have surface types lower than design standards with 2,911 miles, 25 percent, below tolerable conditions
- 7,075 miles, 61 percent, are deficient in surface width. On 2,402 miles, 21 percent, existing widths are less than the minimums considered tolerable
- 6,533 miles, 56 percent, include grades steeper than the maximum considered desirable by design standards for the terrain and traffic volume served
- 6,131 miles, 52 percent, include curves too sharp for safe motor vehicle operation at design speeds. On 2,243 miles, curves are sharper than the condition established as tolerable
- 1,048 bridges, 96 percent, have roadway widths less than design standard widths. On 475 of these bridges the roadway widths are below tolerable minimums; of these, 246 bridges are one-lane widths only
- 867 bridges, 80 percent, do not fully meet standards for load-carrying ability. Of these, 348, or 32 percent, are below tolerable conditions.

SECONDARY ROAD IMPROVEMENT COSTS

Total estimated cost of improvements needed in the next 20 years on the proposed Secondary Road System is $232,541,000. This would include all roadway and structure costs, costs for subsequent resurfacings and stopgaps necessary to keep intolerable sections in service until they can be improved to standards adequate for traffic. The table on page 60 shows a breakdown of the total cost by backlog needs and improvements needed in each of the four future five-year time periods.

Similar information on cost of needed improvements by time periods is available in the files of this study for each of the 56 counties.

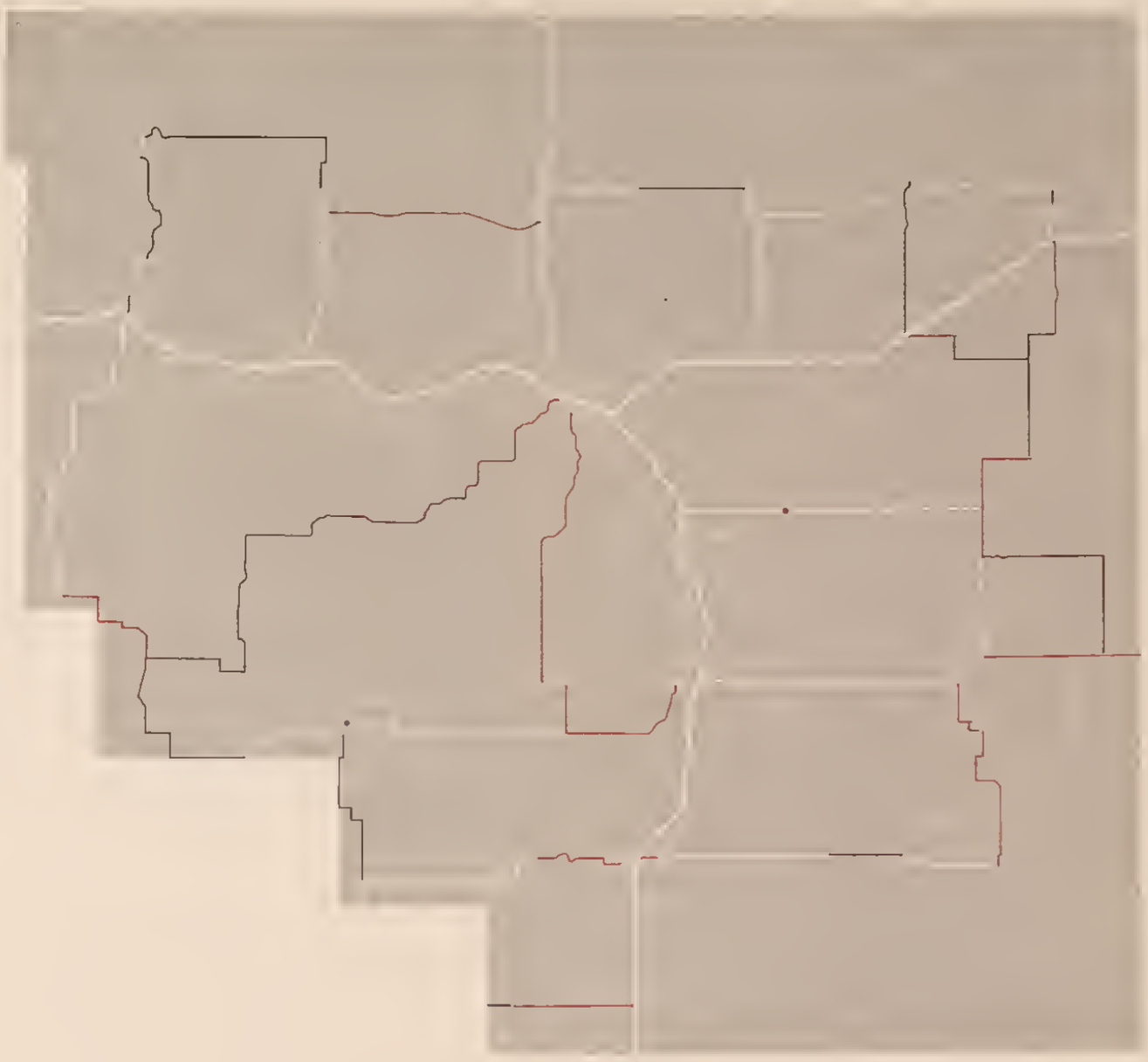
Backlog improvement costs represent 37 percent of the total costs for all needed improvements in the 20-year period. Work included in the backlog involves 4,321 miles of roadway improvements and 500 structures which do not measure up to the minimum levels established as tolerable for today's traffic.

The total 20-year needs involve the following types of work:

CASCADE COUNTY

IMPROVEMENTS NEEDED WITHIN FIVE YEARS ON SECONDARY ROAD SYSTEM

Improvements needed within five yeors on the Secondory Rood System in Coscode ond Sheridon Counties ore illustroted here. Locotions shown in block ore backlog needs ond locotions shown in red ore improvements proposed for the 1-5 yeor period. All of the remoining Secondory Rood System mileoge in these counties will require some kind of improvement in the 20-yeor period. The extent of secondory rood development needed within five yeors in Coscode ond Sheridon Counties is typicol of oll counties.



SHERIDAN COUNTY

Improved secondary roads and bridges pay dividends to users through safer, faster, more economical transportation.

Type of Work	*Cost (In Thousands)*	*Percent*
Surfacing and Minor Widening	$ 23,279	10
Base and Surface	3,591	2
Reconstruction	119,516	52
New Construction	26,116	11
Structures	32,991	14
Stopgaps	5,169	2
Future Surface Replacements	21,879	9
TOTAL	$232,541	100

More than half of the total cost is for reconstruction of existing roads substantially on present alignment. This includes necessary surfacing work. Only about one-eighth of the total cost is for base and surface construction and resurfacing on roadways which substantially meet the design standards.

About 60 percent of the total cost is for improvements needed to overcome existing deficiencies and those accruing within five years.

The maps on pages 62 and 63 illustrate the extent of improvements needed within the next five years in Cascade and Sheridan Counties. The improvements shown on the Cascade County map total 183 miles in length, of which 63 miles would be gravel and 120 miles dustless surface of various types. The improvements shown for Sheridan County total 166 miles in length, of which 59 miles are gravel and 107 miles are dustless surfaces of various types. All of the remaining Secondary Road System mileage in those counties will need some kind of improvement in the 20-year period. The extent of development needed within five years in Cascade and Sheridan counties is typical of that proposed in all counties.

Federal-aid Secondary System

The existing Federal-aid Secondary System in Montana totals approximately 4,000 miles in length or about one-third of the proposed Secondary Road System. New routes are being added to the Federal-aid Secondary System as needs arise. The increase in system length in the last year was about 600 miles. Eventually the rural Federal-aid Secondary System should substantially coincide with the recommended Secondary Road System.

In order to permit evaluation of the effect of increased Federal-aid Secondary funds under the 1956 Federal Aid Act, construction requirements

PROGRAM COSTS
COUNTY ROADS

(In Thousands)

	Secondary Road System Average Annual Costs				Local Roads
	10-Year Period	Second 10 Years of 20-Year Period	15-Year Period	20-Year Period	Average Annual Cost for 20-Year Period
Construction	$18,121	$ 5,138	$14,261	$11,626	$ 9,270
Maintenance and Administration	4,667	4,280	4,551	4,471	4,096
TOTAL ANNUAL PROGRAM COSTS	$22,788	$ 9,418	$18,812	$16,097	$13,366

This poorly surfaced, narrow, crooked road is typical of a large mileage of county roads throughout the state.

on the existing Federal-aid Secondary System over the next 20 years are summarized in the following table:

20-YEAR IDENTIFIED CONSTRUCTION NEEDS

FEDERAL-AID SECONDARY SYSTEM

(In Thousands)

	Backlog	*1957-1976*
Rural	$32,606	$53,026
Urban	1,037	2,080
TOTAL	$33,643	$55,106
GRAND TOTAL		$88,749

The above costs do not include replacements or allowances for stopgap construction. *They are a duplication of, and not in addition to, the needs previously discussed for the proposed Secondary Road System.*

AVERAGE COSTS

Statewide costs per mile for Secondary Road System improvements by type of surface average:

Type of Surface	*Cost Per Mile*
Gravel	$11,100
Bituminous Surface Treatment	17,500
Intermediate Type	21,700
High Type	25,800

These costs exclude structures but include right of way and grading.

Construction costs per mile for each surface type vary widely in different areas of the state, principally because of differences in topography. Construction costs in eastern Montana are generally low, averaging 88 percent of the average statewide costs. On the other hand, per mile costs in mountainous areas are much higher — up to 181 percent — than the statewide averages.

LOCAL COUNTY ROADS

Total cost of improvements required to bring local county roads up to adequate standards in 20 years is $185,400,000 or $9,270,000 annually.

The analysis procedure used in arriving at this amount is based upon the design standards shown in the appendix and a target date 20 years hence to develop all local roads to those standards. No attempt was made to evaluate the relative need of one local road against another or to schedule specific improvements by time periods. Instead the analysis procedure assumes that there should be a uniform average annual rate of improvement in each county over the 20-year period.

It must be recognized that actual costs and rate of progress on local roads will vary between counties depending greatly on desires of the local people and their ability to finance.

If, locally, the standards are considered too high, or the 20-year target date too short, the annual costs will be less. Conversely, if the standards are not considered as an adequate degree of development, or if the 20-year period is judged too long for development, annual costs will be greater.

The total 20-year improvement cost for local county roads involves the following work:

Type of Work	*Cost (In Thousands)*
Heavy Gravel	$ 58,780
Medium Gravel	73,980
Light Gravel	25,820
Streets (Rural Subdivisions)	11,060
Structures	15,760
TOTAL	$185,400

These costs provide for improvement of 366 miles of streets in rural subdivisions adjacent to the larger municipalities in the state; development of 25,014 miles to gravel surfaces adequate for year-round travel and an additional 6,312 miles to gravel surfaces for seasonal use only. The remaining mileage of local county roads, about 14,000 miles, consists of trails which can be kept up by maintenance and for which no construction improvements were estimated. The mileage of trails varies from county to county depending on character of land use and topography.

Information on local road mileages proposed for improvement to the various design classes and improvement costs for each of the 56 counties is available in the files of this engineering study.

ANNUAL PROGRAM COSTS

Alternative programs have been developed for the proposed Secondary Road System based upon overcoming the backlog of existing needs in 10 years, in 15 years, and in 20 years. All three programs provide also for meeting future needs as they occur and for maintenance and administration.

To catch up on the existing backlog of needs in 10 years will require an average annual expenditure of $22,788,000, of which $18,121,000 would be for construction and $4,667,000 for maintenance and administration. Average annual costs for the second 10 years of the 20-year period would be reduced to $9,418,000 under this plan, since the backlog of needs would have been taken

care of and construction would be needed only to meet new requirements and replacements.

A shorter catch-up period than 10 years for overcoming backlog needs is impractical from a construction standpoint. If the findings of the fiscal study show the 10-year catch-up program to be feasible financially, this plan should be adopted since it would provide the benefits of a system of improved roads at an earlier date and without increase in total cost over a 20-year period. If the fiscal study does not show the 10-year catch-up program to be feasible either on a pay-as-you-go or credit financing basis, construction costs for overcoming the backlog needs will have to be spread over longer time periods.

To catch up on backlog needs in 15 years will require an average annual expenditure of $18,812,000. For the next five years, the annual cost would drop to $7,976,000.

The average annual cost of a 20-year catch-up program for the proposed Secondary Road System would be $16,097,000.

While the average annual requirements for the 15 and 20-year catch-up programs are less, total cost for the 20-year period remains the same as for the 10-year program. Under either the 15 or 20-year catch-up plans some of the needs of the first 10 years would be deferred until later years. Deferring needed construction and spreading the backlog over longer periods of time would mean deferring benefits resulting from improved and adequate roads.

The average annual cost for bringing local roads to adequate standards over a 20-year period is $13,366,000. Of this, $9,270,000 is to meet construction requirements; $4,096,000 is for maintenance and administration.

Annual program costs for each of the 56 counties under each of the three alternative plans for meeting the long range needs of the proposed Secondary Road System and for local roads are shown in the appendix.

Maintenance and Administration Costs

Amounts for maintenance in each of the various programs have been based on a special analysis of maintenance costs by the engineering staff with the assistance of engineers from the U. S. Bureau of Public Roads and the Maintenance Advisory Committee listed on page 4.

Maintenance practices and costs vary widely between counties. The total reported maintenance expenditures by all counties last year was $6.7 million, including some betterments, or an average of approximately $153 per mile of road maintained. Some counties reported average costs as low as $50 per mile — others as high as $650 per mile. While some of this difference is caused by volume of traffic, character and width of surfaces, amount of snowfall, etc., it is evident from field observations and interviews in a number of counties that quality of maintenance performance varies greatly. As examples, some counties blade earth and gravel surfaces twice a year; others report blading as needed up to six or eight times a year. Some counties mow or chemically treat shoulders only — others perform this operation for the full width of the right of way.

A part of the variance in level of maintenance performance between counties is attributable to lack of funds for an adequate maintenance budget; part is due to differences in management and lack of technical help. There is need for the counties to collectively establish and adopt standard maintenance procedures. In addition there is need for a uniform system of maintenance cost accounting records in each county as recommended in Chapter 3.

It is estimated that an average annual expenditure of $7.9 million over the 20-year period will provide a full level of maintenance performance on county roads. About half of this amount would be required for the proposed Secondary Road System — about half for local county roads. This is equivalent to $330 per mile on the average for the Secondary Road System; $120 per mile for local roads exclusive of trails.

Administration costs have been estimated for each program at three percent of the total construction and maintenance costs for the proposed Secondary Road System and one percent for local roads. Those percentage allowances provide for all overhead and operating expenses exclusive of project engineering. Direct costs of project engineering were included as a part of the estimated construction costs.

CONCLUSIONS

Roads inadequate to accommodate traffic safely and efficiently are expensive both to the users who rely upon them and to the highway agency responsible for their upkeep.

The various programs presented in this chapter establish a sound base for adoption of an equitable fiscal plan related to needs and geared to the economy of the state and the various counties.

An adequate fiscal plan, however, will not insure development of adequate roads. The improvement programs proposed can only be executed effectively and economically through sound management and engineering. The changes in county highway administration recommended in Chapter 3 are essential to the successful carrying out of whatever improvement program is adopted.

Chapter 6

municipal streets

INCLUDING URBAN EXTENSIONS of State Highways, there are about 1,650 miles of streets in the 123 municipalities in Montana. Those streets represent only two percent of the state's total road and street mileage but carry 15 percent of all travel. Of the travel in municipalities about 40 percent is on State Highway routes; the remaining 60 percent on other streets.

The estimated cost of all street improvements needed in the next 20 years is over $90 million, or 8 percent of total road and street needs. This includes $36 million for urban State Highway improvements discussed in Chapter 4.

Needed improvements during the 20-year period on the arterial street systems, recommended in Chapter 2, are estimated to cost a total of $18 million. Of this amount, about one-third is for improvements needed now to remedy backlog deficiencies.

Costs of the 20-year improvement needs on all local streets total $36 million.

All of those costs are for construction only, including necessary stopgap work and future resurfacings. They do not include allowances for maintenance and administration.

APPRAISAL PROCEDURE

The entire street network of each municipality serves traffic without regard to jurisdictional responsibility for upkeep and maintenance of the various street systems.

In the appraisal of street needs, the principal objective was to provide an integrated system of arterial streets, and urban State Highways, consistent with modern engineering practice and good city planning. Consideration was given to the best means of fitting present street facilities into the desirable future plan at least cost.

For each of the 13 cities of over 5,000 population, conferences were held to study the problems and reach decisions as to how the development of an integrated arterial street plan could best be achieved. Those determinations were made jointly by city officials, representatives of the State Highway Department and members of the study engineering staff. Use was made of all available information including origin and destination

Angle and double parking, signals, and pedestrians impede the orderly flow of through traffic. US 91, an Interstate route in Dillon, is an example of this condition. New locations of Interstate routes in most instances would bypass municipalities.

City streets represent only two percent of Montana's total mileage but carry 15 percent of all travel. Traffic congestion produces costly economic losses through delays, accidents, extra gasoline consumption and other excessive motor vehicle operating costs.

Channelization of intersections, such as this one in Helena, would do much to eliminate congestion by requiring more orderly traffic movement. This type of improvement can be made at relatively inexpensive cost.

studies, traffic surveys, inventory and physical condition data, current programs and planning.

Improved operational controls, such as removal of parking during peak hours, banning of diagonal parking, and establishment of one-way streets were studied before street widenings and other major construction projects were determined as proper solutions. During the various conferences work sheets were prepared covering each improvement jointly agreed upon as necessary.

In municipalities of less than 5,000 population, where traffic problems are generally less complex, urban extensions of the proposed State Highway System and urban extensions of the proposed rural Secondary Road System constitute an adequate integrated arterial plan. For this group of municipalities the urban extensions of rural secondary roads have been classified in this study as arterial streets.

Details of the procedure used in appraisal of arterial street needs are contained in the manual "Engineering Procedures and Instructions for Determining Municipal Street Needs." This manual was prepared with the assistance of the City Engineer Advisory Committee. Copies of the manual can be obtained from the Fact Finding Committee on Highways, Streets and Bridges and the State Highway Commission.

Needs on local streets were appraised by means of a statistical process to determine the annual cost of improvement to adequate standards over a 20-year period. This analysis was made by the engineering staff based upon inventory records of the Highway Planning Survey and reports from a sample of municipalities in each population group on physical characteristics and conditions of streets.

Standards

The design standards for arterial streets call for high type surfaces in downtown areas and in developed residential areas where traffic volumes

warrant. In outlying areas lower types of dustless surfacing were called for. Strict adherence to a rigid set of geometric design standards is not practical nor reasonable in developed areas where property values are high and costs of acquiring additional right of way expensive. For this reason, widenings of existing streets were restricted generally to maximum widths obtainable within existing right of way. Where this would not provide sufficient capacity, or minimum widths necessary for the safety and convenience of traffic, one-way pairs were used where feasible. In those cases where new facilities proved to be the only practical solution, the new construction standards for arterial streets, shown in the appendix, were followed.

There are no national standards for municipal streets, nor are there uniform street standards in use by all Montana municipalities. The new construction standards for arterial streets developed for this study agree with the best practices used by Montana municipalities and in municipalities of comparable size elsewhere in the nation.

The design standards for local streets are based on area and service characteristics. Provision of gravel surfaces, capable of year-round travel, was called for as a minimum in municipalities of less than 5,000 population. In larger cities bituminous surface treatments were called for as a minimum in outlying areas with sparse development. In all municipalities, higher types of surfaces were specified where area characteristics and volumes of traffic warranted. In all cases, improvements proposed for existing local streets are based on obtaining maximum salvage value from the existing investment.

PHYSICAL NEEDS ON ARTERIAL STREETS

Arterial street needs of individual cities vary widely, both as to type of work and urgency. In the three cities of over 25,000 population, where 40 percent of all city travel is concentrated and where needs are greatest, results of the engineering appraisal have been analyzed separately. The needs in all other municipalities have been summarized by population groups. However, work sheets are available in the study files, showing project by project arterial street needs for all municipalities.

All of the 209 miles of proposed arterial streets will require some kind of improvement during the next 20 years. Needs range from resurfacing of existing streets, without geometric change, to construction of a limited mileage of new facilities. The total miles of each surface type proposed in the study period are:

Surface Type	*Miles*	*Percent*
High Type — 4 travel lanes	77.68	37
High Type — 2 travel lanes	77.60	37
Intermediate Type	36.91	18
Bituminous Surface Treatment	16.61	8
TOTAL	208.80	100

Most of the mileage of bituminous surface treatments is in municipalities of less than 1,000 population.

Of the total of 209 miles of improvements, 26 percent is needed now to correct backlog deficiencies; a total of 53 percent is needed within five years; 81 percent in 10 years and 96 percent within 15 years.

Lack of proper drainage is a serious deficiency of some streets in many municipalities. Not only does inadequate drainage constitute a hazard and inconvenience to traffic during and immediately after periods of rainfall but it is a primary cause of pavement deterioration, particularly when water becomes trapped beneath the surface and saturates the subgrade. When necessary, costs for inlets, storm drain connections and laterals were included as part of municipal street improvement costs. However, costs for main drains and interceptors for area drainage were not included since the entire costs of such facilities are not a proper charge against street revenues. Additional municipal expenditures will be involved, therefore, in those areas where main storm drains and interceptors are not now in existence, if proper drainage is to be provided.

ARTERIAL STREET IMPROVEMENT COSTS

Total estimated cost of improvements needed on arterial streets in the next 20 years is $17,690,000. This includes all roadway and structure costs; costs for future resurfacings and stopgap allowances to keep intolerable streets in service until such time as construction improvement can be made. The table on page 70 shows accumulatively the 20-year cost by backlog needs and future improvements in four time periods of five years each.

A distribution of the total 20-year arterial street improvement costs by the three cities of over 25,000 population and by population groups is shown in the following table:

Place or Population Group	*No. of Places*	*Improvement Miles*	*Total 20-Year Arterial Street Costs (In Thousands)*
Billings	1	22.84	$ 3,660
Butte	1	14.28	1,949
Great Falls	1	31.03	2,132
10,000 to 25,000	4	39.98	4,213
5,000 to 9,999	6	35.05	2,930
2,500 to 4,999	12	4.84	179
1,000 to 2,499	28	18.89	659
1 to 999	70	41.89	1,968
TOTAL	123	208.80	$17,690

Costs of backlog improvements needed to correct existing intolerable deficiencies represent 34 percent of the 20-year costs. The total 20-year

ACCUMULATIVE CONSTRUCTION NEEDS
PROPOSED ARTERIAL STREET SYSTEM
(Including Right of Way)
(In Thousands)

Period	*Roadway*	*Structures*	*Total*
Backlog	$ 3,818	$ 2,237	$ 6,055
5 Years	7,621	3,178	10,799
10 Years	11,274	3,703	14,977
15 Years	12,861	3,966	16,827
20 Years	13,724	3,966	17,690

needs involve the following types of construction:

Type of Construction	*Cost (In Thousands)*	*Percent*
High Type — 4 travel lanes	$ 6,999	40
High Type — 2 travel lanes	3,569	20
Intermediate Type	1,633	9
Bituminous Surface Treatment	338	2
Structures	3,966	22
Stopgaps	291	2
Future Surface Replacements	894	5
TOTAL	$17,690	100

About 61 percent of the total is for improvements needed within five years to remedy backlog deficiencies and those accruing within that time.

The map on page 71 shows the location of arterial street improvements needed in Billings within five years. Also shown are needed improvements on the proposed State Highway System within the same period. The arterial street improvements total 11 miles in length including a viaduct structure over the Northern Pacific railroad yards on the line of 32nd Street. The estimated cost of these improvements is $2,302,000. The improvements on the proposed State Highway System total five miles in length, including two separations of the Northern Pacific tracks. Total estimated cost of these improvements is $2,243,000. The proposed State Highway improvements on South 27th Street and South 28th Street are a one-way pair connecting with the proposed location of Interstate System Route US 10 bypassing the city on the south.

AVERAGE COSTS

The average cost of all arterial street improvements needed in the next 20 years is $84,700 per mile. This includes right of way and structures. The average cost in cities of over 25,000 population is $113,500; in cities from 10,000 to 25,000 population $105,300; in municipalities from 5,000 to 10,000 population $83,600; and in municipalities under 5,000 population $42,800.

By type of surface, average costs per mile for arterial street improvements are:

Type of Surface	*Cost Per Mile*
High Type — 4 travel lanes	$90,100
High Type — 2 travel lanes	46,000
Intermediate Type	44,200
Bituminous Surface Treatments	20,300

These costs exclude structures but include right of way and grading.

Construction costs per mile for each surface type vary widely between projects depending on the amount of salvage in the existing facility.

LOCAL STREETS

The total cost of improvements estimated to bring local streets up to standards in 20 years is $36,440,000, or $1,822,000 annually. A distribution of the total 20-year costs by the three cities of over 25,000 population and by population groups is shown in the following table:

Place or Population Group	*Total 20-Year Local Street Costs (In Thousands)*
Billings	$ 2,600
Butte	3,860
Great Falls	3,500
10,000 to 25,000	5,680
5,000 to 9,999	4,820
2,500 to 4,999	6,480
1,000 to 2,499	5,500
1 to 999	4,000
TOTAL	$36,440

The statistical process used in estimating local street improvement costs is based on the design

standards included in the appendix and a target period of 20 years in which to develop all local streets to those standards. The procedures used do not measure the relative need of one local street against another or schedule improvements by time periods as was done on arterial streets. Instead the statistical process assumes a uniform average annual rate of improvement in each municipality over the 20-year period.

Actually, improvement costs and rate of progress on local streets will vary greatly depending on the desires of the local people as to standards, rate of improvement and on ability to finance. If, locally, standards used in this appraisal are considered too high, or the 20-year period too short, annual costs will be less. On the other hand, if standards used are not considered as an adequate degree of development, or if the 20-year period is too long for improvement of all streets, annual costs will be greater.

The total 20-year improvement cost for local streets involves the following work:

Type of Work	*Cost (In Thousands)*
High Type Surfaces	$ 3,900
Intermediate Type	17,120
Bituminous Surface Treatment	12,340
Gravel	3,080
TOTAL	$36,440

These costs provide for improvement of 111 miles of high type surfaces, 369 miles of intermediate type, 495 miles of bituminous surface treatments and 313 miles of gravel. All of the mileage of gravel surfaces is in municipalities of less than 5,000 population, 162 miles being in municipalities of less than 1,000 population.

A breakdown of the total 20-year improvement costs by surface type for each of the three cities

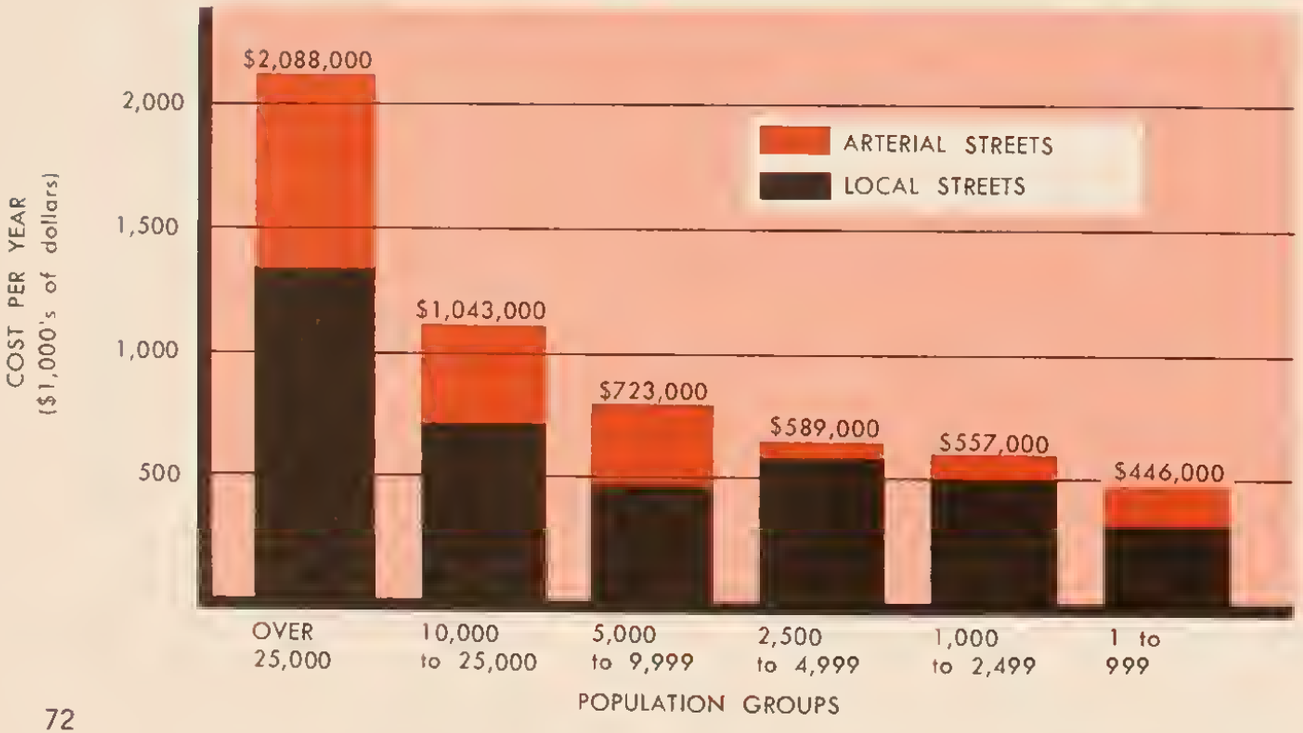
IMPROVEMENTS NEEDED WITHIN FIVE YEARS ON MAJOR SYSTEMS IN BILLINGS

Location of improvements needed within five years in Billings on the proposed State Highway and Arterial Streets Systems are shown on this map. Sections in black are State Highway needs. Sections in red are on the proposed Arterial Street System. Backlog needs are shown in solid red. Needs of the 1-5 year period are shown by dashed red.

20-YEAR CONSTRUCTION COSTS
LOCAL STREETS
(In Thousands)

Place or Population Group	*Surface Type*			
	High	*Intermediate*	*Bituminous Surface Treatment*	*Gravel*
Billings	$ 380	$ 1,480	$ 740	$ —
Butte	660	2,120	1,080	—
Great Falls	560	1,960	980	—
10,000 to 25,000	860	3,220	1,600	—
5,000 to 9,999	720	2,740	1,360	—
2,500 to 4,999	720	3,900	1,760	100
1,000 to 2,499	—	940	3,140	1,420
1 to 999	—	760	1,680	1,560
TOTAL	$3,900	$17,120	$12,340	$3,080

AVERAGE ANNUAL 20-YEAR PROGRAM COSTS
MUNICIPAL STREETS



over 25,000 population and by population groups is shown in the table on this page.

ANNUAL PROGRAM COSTS

Annual costs of three alternative programs for arterial streets and average annual 20-year program costs for local streets are shown in the table on page 73. A breakdown of those program costs for each city of over 25,000 population and by population groups for smaller municipalities is included in the appendix.

The 10-year annual program cost for arterial streets provides for overcoming all backlog needs as well as those accruing during the first 10 years of the 20-year period. Since the improvement needs of the first 10 years are about 85 percent of total needs, annual construction requirements are approximately five times as great as for the second 10 years. The annual cost for the second 10 years provides only for needs developing during that period, as well as necessary maintenance and administration.

The program costs for 15 and 20-year catch-up periods for arterial streets are averages of all costs for the respective periods. In the case of the 15-year catch-up program, the cost for the last five years of the 20-year period is reduced to $825,000 annually. Under either of these two programs, some of the improvements needed in the first 10 years would be deferred until later years. While spreading the program over longer catch-up periods reduces annual requirements in early years, it also means deferring benefits and savings to users which would result from construction of improvements when needed. Under all three plans, the total 20-year costs are the same.

The average annual cost for bringing local streets to adequate standards over a 20-year period is $3,889,000. Of this amount, $1,822,000

is for construction; $2,067,000 is for maintenance and administration. About one-third of the total annual cost is for local streets in the three cities of over 25,000 population; one-third for local streets in cities of 5,000 to 25,000 population, and one-third for local streets in municipalities of less than 5,000 population.

Maintenance and Administration Costs

Amounts included for maintenance in each of the various programs were developed from analysis of reports by Montana municipalities and the experience of municipal engineers and other municipal officials.

Street maintenance costs vary widely. The total reported street maintenance expenditures by all municipalities last year was $2.1 million. This is an average of $1,390 per mile. It includes in addition to routine surface maintenance, street cleaning and flushing, care of drainage facilities, sidewalk repair, snow and ice control and in some places all or part of the cost of street lighting.

The reported 1955 street maintenance expenditures range from an average of $2,500 per mile in cities of over 25,000 population downward to $325 per mile in municipalities of less than 1,000 population. The higher costs in the larger cities are mainly due to volume of traffic, character and width of surfaces and public demand for increased traffic services, such as cleaning, flushing, traffic lane and cross-walk markings, traffic lights, etc., particularly in downtown areas.

It is estimated that an average annual expenditure of $2.6 million over the 20-year period will provide an adequate level of maintenance performance for all municipal streets. About 25 percent of this amount would be required for arterial streets; 75 percent for local streets. This is equivalent to $3,000 per mile, on the average,

Many city streets serve heavy trucks as well as lighter vehicles. Good maintenance is on essential to efficient traffic movement.

PROGRAM COSTS
MUNICIPAL STREETS
(Excluding State Highways)
(In Thousands)

	Arterial Streets — Average Annual Costs				Local Streets
	10-Year Period	Second 10 Years of 20-Year Period	15-Year Period	20-Year Period	Average Annual Cost for 20-Year Period
Construction	$1,499	$272	$1,121	$ 884	$1,822
Maintenance and Administration	691	655	680	673	2,067
TOTAL ANNUAL PROGRAM COSTS	$2,190	$927	$1,801	$1,557	$3,889

for arterial streets and $1,520 per mile for local streets. The arterial street maintenance costs are estimated to range from $4,700 per mile in cities over 25,000 population to $540 per mile in municipalities of less than 1,000 population. The local street maintenance costs are estimated to average $3,000 per mile in cities over 25,000 population downward to $460 per mile in municipalities of less than 1,000 population.

Administration costs have been estimated for each program at three percent of the total construction and maintenance costs. That provides for overhead and operating expenses exclusive of project engineering. Direct costs of project engineering were included as a part of the estimated cost of construction.

CONCLUSIONS

Street systems adequate for safe and efficient traffic movements are vital to the economic welfare of all municipalities. Failure to provide for the orderly flow of vehicles to and from the central business district and other generators of major traffic movements results in costly losses to the user as well as to business establishments and the community at large.

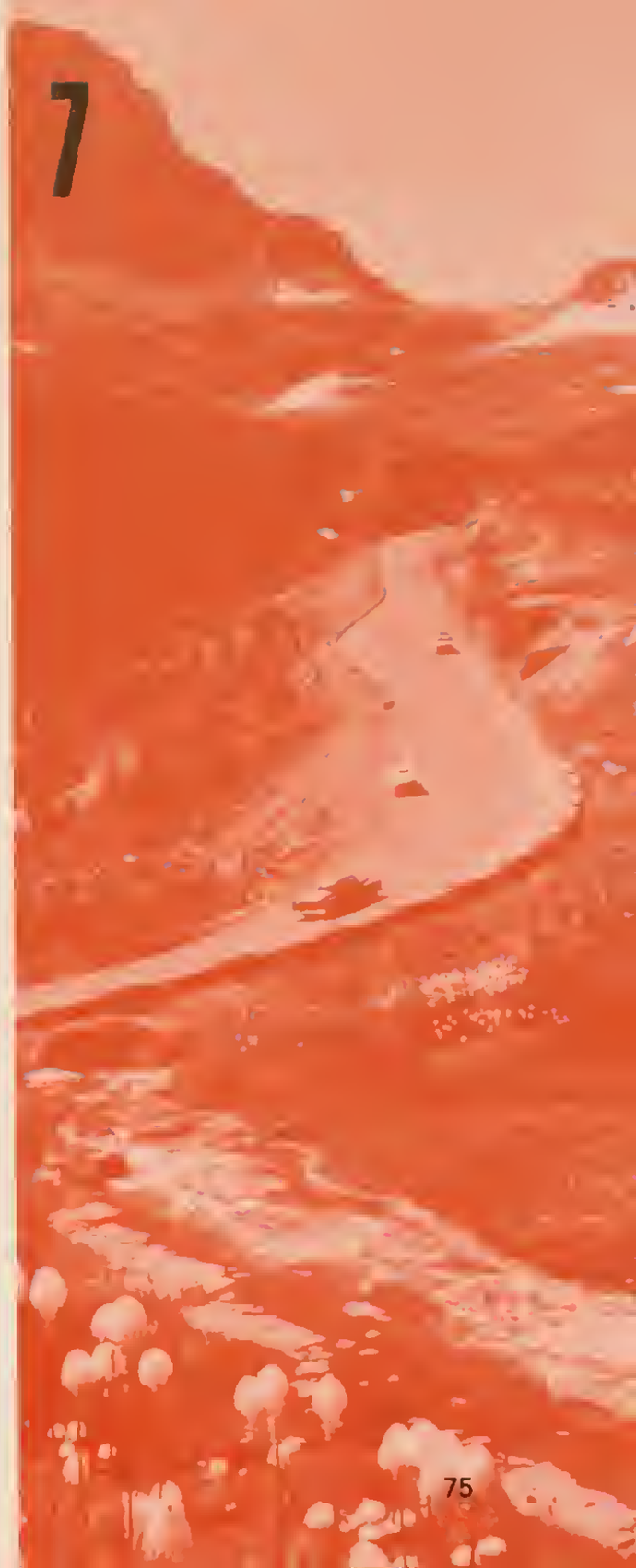
All municipalities over 2,500 population should develop and keep current long range master plans to control orderly and economic municipal growth through land-use zoning. A master street plan properly integrated with urban State Highway extensions should be officially adopted to guide orderly development of construction programs.

In many municipalities there is need for greater effort in the traffic engineering field. Much can be accomplished in solving congestion problems at intersections and in expediting traffic movements through application of proven and established traffic operation techniques.

Smaller municipalities where full time engineering staffs for construction and maintenance of street systems are not warranted, or feasible, should utilize technical services of counties and the State Highway Department as needed, as recommended in Chapter 3.

Chapter 7

evaluation



THE ESTIMATED TOTAL COST of all improvements needed by 1976 on the major road and street systems — State Highways, secondary roads and arterial city streets — is $928 million. Maintenance and administration are estimated to cost an additional $307 million, making a total financial requirement during the next 20 years of $1.235 billion for those major systems. Of the total, $882 million, 71 percent, is needed for State Highways; $322 million, 26 percent, for secondary roads and $31 million, three percent, for city arterials.

An additional $345 million would be required in the 20-year period for development and maintenance of local roads and streets to study standards. Actual expenditures and progress made on those local systems will vary depending on the desires of the local people as to standards, rate of improvement and on ability to finance.

The 20-year cost for all road and street systems totals $1.58 billion of which $1.15 billion is for construction; $430 million is for maintenance and administration. About three-fourths of the total construction cost is for improvements needed on the various systems, except local roads and streets, within the next 10 years.

The total 20-year financial requirements are unquestionably large and may appear, when considered only in total, to be unrealistic and not attainable without severe burden on the people of the state. On the basis of annual requirements, the cost is not formidable. A substantial part of the cost will be financed by Federal aid under the expanded program authorized by the 1956 Federal-aid Highway Act.

Based on the results of this engineering appraisal, the separate fiscal study will evaluate need for tax revision and the distribution of highway revenues to the various road and street systems. Each system presently has different sources of support in varying degrees from Federal aid, state motor vehicle taxes, property taxes and other miscellaneous funds. The fiscal study will take into account the major increase in Federal funds under the 1956 Act and the reduced state matching requirements on the Interstate System. Possibilities of credit financing to accelerate construction on at least a portion of the major road and street systems will be analyzed.

PROGRAM ALTERNATES

In preceding chapters various alternative pro-

grams have been presented for meeting the long range needs of each road and street system.

Annual costs for a 20-year catch-up program on all roads and streets are summarized in Table 1. An average of $85,922,000 annually is required for the first 13 years; an average of $66,184,000 annually for the next seven years. The higher annual cost for the first 13 years is due to providing for completion of the Interstate System within that time period as provided for by the 1956 Federal-aid Highway Act.

Under the 20-year catch-up program about one-fourth of the improvements needed on all major road and street systems within the next 10 years would be deferred until the second 10 years of the 20-year period. While the average annual costs are less, deferment of needed construction means loss of benefits and savings to users which result from improved and adequate highways.

Table II, page 78, summarizes the average annual costs for a 10-year catch-up program for the major road and street systems. Total annual requirements for the first 10 years are $87,780,000; for the next three years, $49,571,000 and for the next seven years, $29,833,000. Those amounts do not provide for local road and strect systems. Program costs for those systems were determined only on a basis of a 20-year catch-up period. As shown by Table 1, the annual cost for development and maintenance of local roads and local streets totals $17,255,000.

Under the 10-year catch-up program, costs during the second 10 years are only 41 percent of the total cost for the first 10 years, since the backlog would have been overcome and the continuing program would be on a current basis.

TABLE I
20-YEAR CATCH-UP PROGRAM FOR ALL ROADS AND STREETS
(In Thousands)

	Average Annual Costs for 20-Year Period					
	First 13 Years			*Next 7 Years*		
System	*Construction*	*Maintenance and Administration*	*Total*	*Construction*	*Maintenance and Administration*	*Total*
Interstate Routes	$20,899			$ 2,101		
Other State Highways	19,578			19,578		
Total All State Highways	$40,477	$10,536	$51,013	$21,679	$ 9,596	$31,275
Secondary Roads	11,626	4,471	16,097	11,626	4,471	16,097
Arterial Streets	884	673	1,557	884	673	1,557
Sub-Total Major Road and Street Systems	$52,987	$15,680	$68,667	$34.189	$14,740	$48,929
Local Roads	$ 9,270	$ 4,096	$13,366	$ 9,270	$ 4,096	$13,366
Local Streets	1,822	2,067	3,889	1,822	2,067	3,889
Sub-Total Local Roads and Streets	$11,092	$ 6,163	$17,255	$11,092	$ 6,163	$17,255
TOTAL ALL ROADS AND STREETS	$64,079	$21,843	$85,922	$45,281	$20,903	$66,184

Annual costs for a 15-year catch-up program on major road and street systems are summarized in Table III on page 79. This plan would require an average annual expenditure of $76,600,000 during the first 13 years, $56,862,000 per year during the next two years and $25,154,000 annually for the next five years. As in the case of the summary 10-year catch-up program, an additional $17,255,000 would be required annually over a 20-year period for development and maintenance of local roads and streets.

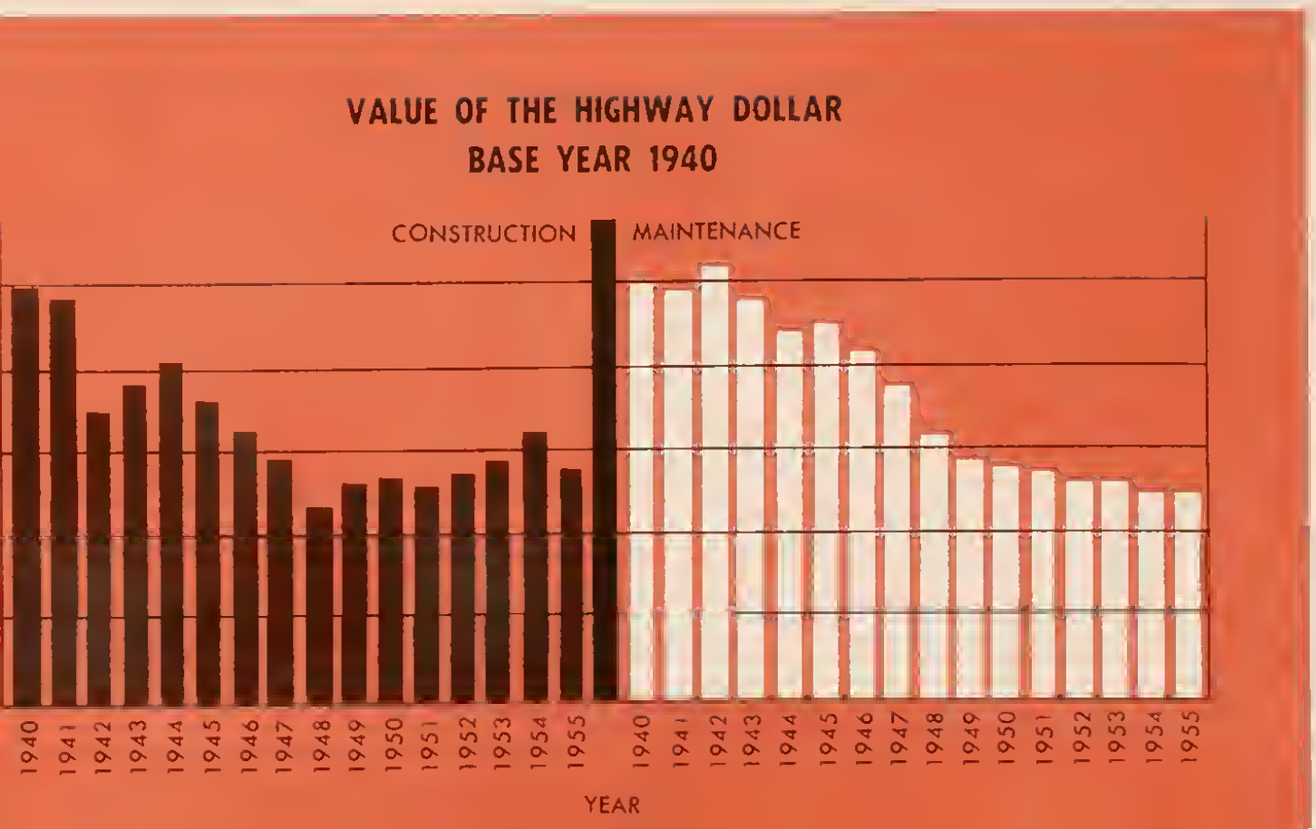
Under the 15-year catch-up program, about one-seventh of the first 10-year needs would be deferred for up to five years.

The total 20-year cost under all three plans is the same.

Effect of Prices

The accompanying chart shows the trend in value of the highway construction and maintenance dollar in Montana since 1940. The construction dollar, using 1940 as a base, was worth 55 cents in 1955; the maintenance dollar in relation to the same base year was worth 47 cents. As with many elements of day-to-day costs, most of this inflation in highway prices occurred during World War II. During the post war period, there has been some tendency for prices to level off. The 1955 value of the highway construction dollar is equal to the average of the 1947-1955 period.

Program costs are based on 1955 price levels. No attempt has been made to anticipate or adjust to possible future price levels. Should highway construction and maintenance costs go down, programs could be completed more quickly or annual financial requirements could be adjusted to correspond to the reduction in price level. If prices go up in the future, the reverse would be true.



Periodic comparison of future construction and maintenance cost indices with 1955 price levels will provide basic data for adjustment of programs to new price levels and for measuring actual progress in development of adequate road and street systems.

Acceleration

The Federal-aid Highway Act of 1956 establishes a 13-year construction plan for development of the National System of Interstate and Defense Highways. This plan is so advantageous in its financial provisions, and the routes are of such great importance, that it is inconceivable that Montana, along with other states, would not provide for necessary matching funds.

As detailed in preceding chapters, the section-by-section appraisal points to a large backlog of work needed to overcome intolerable conditions on portions of State Highways, excluding Interstate routes, and on portions of the proposed Secondary Road System, and the proposed arterial street system. From an economic viewpoint, it would be highly desirable to overcome this backlog of needs, and meet new needs as they occur, within a 10-year period. This appears to be entirely feasible from a construction standpoint. A shorter catch-up period is hardly practical even should it prove feasible from a financial standpoint.

The fiscal study may show the desirability of bond financing for completion of a 10-year catch-up program on at least a portion of the major road and street systems, excluding Interstate routes. Construction requirements, after completion of the 10-year catch-up program, will decrease. This might make it possible to meet credit financing payments and continuing construction and maintenance requirements, without increase in income above that required for a 20-year catch-up program.

State Highways Other Than Interstate Rautes

Cost of improvements needed on State Highways, excluding Interstate routes, within 10 years totals $308,050,000. This is about 77 percent of total 20-year construction needs. About 45 percent of the 10-year costs is for improvements needed now to remedy existing intolerable conditions. Because of the large cost of backlog needs and because of increased traffic, it is recommended that any program acceleration by bond financing found feasible by the fiscal study be applied first to taking care of State Highways. This would result in the greatest savings and benefits to users.

Secandary Raad System

About 77 percent of the total 20-year improvement costs on the proposed Secondary Road System is for needs within 10 years. Backlog needs are 47 percent of the total 10-year needs. Among individual counties, the percentage of total 20-year costs represented by needs within 10 years varies widely.

Any plan for program acceleration on the proposed Secondary Road System should be related to management responsibility for this system as recommended in Chapter 2. There would be no practical reason to encourage program acceleration until such time as counties are adequately staffed and equipped to handle the work load.

Of greater immediate importance is the creation of a state-aid finance plan for secondary roads based upon the appropriate degree of state interest in the system as determined by the fiscal study. It is recommended that the finance plan be based on the principles of state and Federal-aid relationships, proved so effective over the years. Provision should be made for matching funds from local sources, possibly on a sliding-scale ratio based upon relative ability of the counties to finance. The finance plan should be geared to the changes in county highway management and administration recommended in Chapter 3. It should include incentive features designed to induce and aid counties to develop adequate highway departments. One such feature that has proved successful in some states is the earmarking of a specific sum for use in meeting engineering and administration expenses.

Arterial Streets

Backlog needs on the proposed arterial street system are 40 percent of the total 10-year

TABLE II
10-YEAR CATCH-UP PROGRAM FOR MAJOR ROAD AND STREET SYSTEMS
(In Thousands)

	Average Annual Costs for 20-Year Period								
	First 10 Years			*Next 3 Years*			*Next 7 Years*		
System	*Construction*	*Maintenance and Administration*	*Total*	*Construction*	*Maintenance and Administration*	*Total*	*Construction*	*Maintenance and Administration*	*Total*
Interstate Routes	$20,899			$20,899			$ 2,101		
Other State Highways	30,805			8,352			8,352		
Total All State Highways	$51,704	$11,098	$62,802	$29,251	$ 9,975	$39,226	$10,453	$ 9,035	$19,488
Secondary Roads	18,121	4,667	22,788	5,138	4,280	9,418	5,138	4,280	9,418
Arterial Streets	1,499	691	2,190	272	655	927	272	655	927
TOTAL MAJOR ROAD AND STREET SYSTEMS	$71,324	$16,456	$87,780	$34,661	$14,910	$49,571	$15,863	$13,970	$29,833

Does not include local road and street systems. Program costs for those systems were developed only on basis of a 20-year catch-up period.

improvement costs. Improvements needed within 10 years represent 85 percent of the total 20-year costs. However, in comparison with total requirements on major rural systems, the annual costs for arterial streets are small. While program acceleration for arterial streets is desirable, it would appear that it should generally be financed on a pay-as-you-go basis. With exception of possibly the three cities of over 25,000 population where annual costs for a 10-year catch-up program are in excess of $200,000, use of bond financing would appear to be unnecessary.

System Responsibilities

The various alternative program costs discussed in this and preceding chapters are based upon the classification plan recommended in Chapter 2. Should the assignment of jurisdictional responsibilities recommended by the classification plan not be adopted, or should it be adopted with major changes in system responsibility, adjustment of the program costs will be necessary to reflect shifts in cost between systems and agencies of government. This adjustment process can be accomplished by use of the work sheets and basic data developed from the engineering appraisal.

PROGRAM RELATIONS

Over the next 20 years an average of $79 million annually is needed for all road and street systems. As reported in Chapter 1, motor vehicle travel is expected to average 3.8 billion vehicle miles annually over that period. Thus the average annual cost for all roads and streets is equivalent to 2.1 cents per vehicle mile of travel.

This cost per vehicle mile of travel is high in comparison with some other states where similar studies have been made. Two factors contributing to the higher cost in Montana are the large area and comparatively small population. The cost per vehicle mile is about one-third more than the present level of road and street support per vehicle mile of travel. As shown by the chart in Chapter 1, total receipts from all sources in 1955 exceeded $40 million. Travel was approximately 2.7 billion vehicle miles. Thus, 1955 road and street revenues from all sources were equal to 1.5 cents per vehicle mile of travel. A little over half of the 1955 revenues came from state motor vehicle and motor fuel taxes.

Estimated revenues for road and street purposes from all sources for 1957 exceed $60 million. This is based on current fuel and

TABLE III
15-YEAR CATCH-UP PROGRAM FOR MAJOR ROAD AND STREET SYSTEMS
(In Thousands)

	Average Annual Costs for 20-Year Period								
	First 13 Years			*Next 2 Years*			*Next 5 Years*		
System	*Construction*	*Maintenance and Administration*	*Total*	*Construction*	*Maintenance and Administration*	*Total*	*Construction*	*Maintenance and Administration*	*Total*
Interstate Routes	$20,899			$ 2,101			$ 2,101		
Other State Highways	24,315			24,315			5,368		
Total All State Highways	$45,214	$10,773	$55,987	$26,416	$ 9,833	$36,249	$ 7,469	$ 8,884	$16,353
Secondary Roads	14,261	4,551	18,812	14,261	4,551	18,812	3,709	4,267	7,976
Arterial Streets	1,121	680	1,801	1,121	680	1,801	173	652	825
TOTAL MAJOR ROAD AND STREET SYSTEMS	$60,596	$16,004	$76,600	$41,798	$15,064	$56,862	$11,351	$13,803	$25,154

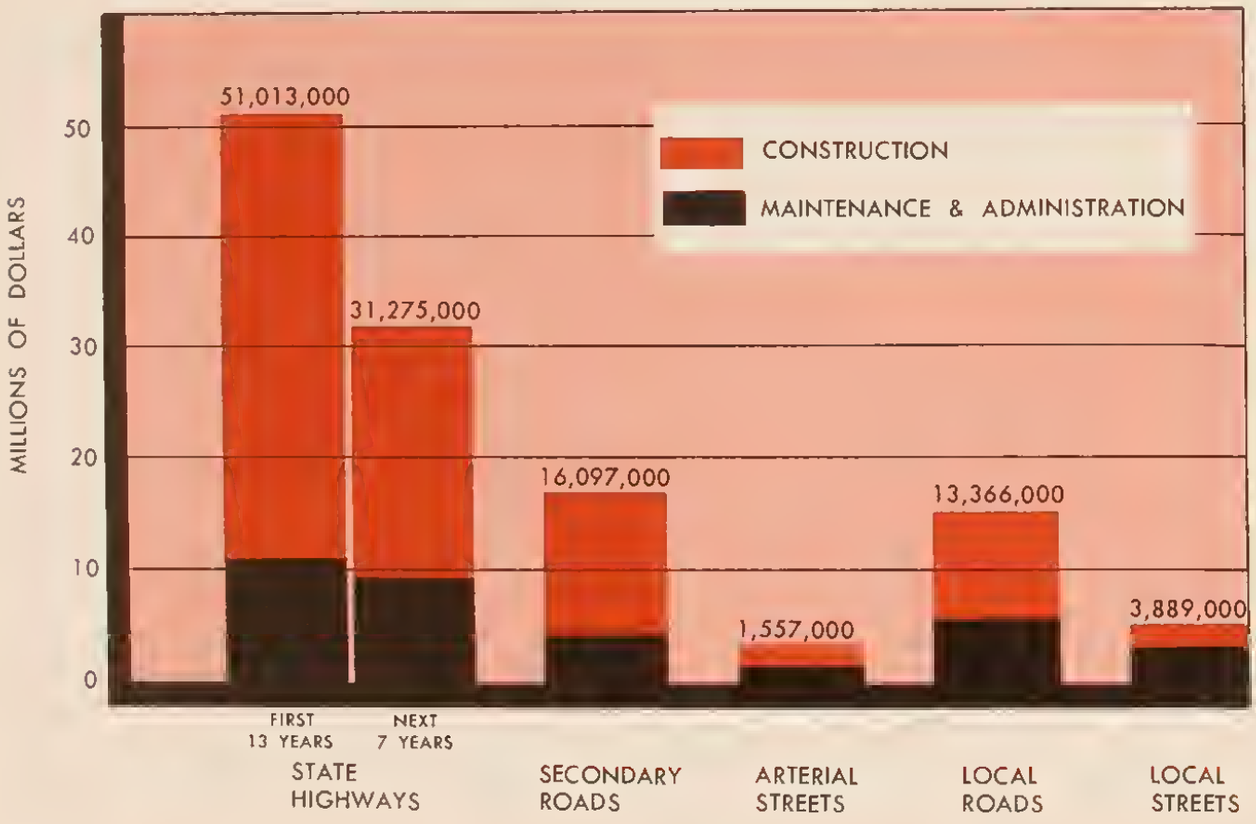
Does not include local road and street systems. Program costs for those systems were developed only on basis of a 20-year catch-up period.

motor vehicle tax rates, local support and miscellaneous receipts at present levels and Federal aid already allotted for the 1957 fiscal year. If full use is to be made of the increased Federal-aid apportionments, some provision will need to be made for additional matching funds. Present state funds are insufficient to take full advantage of the Federal-aid funds available for construction and also to meet requirements for maintenance and administration.

At existing tax rates, receipts from state motor vehicle imposts will increase a total of approximately $180 million during the next 20 years due to growth in travel and in motor vehicle registration. This will provide an average of about $9 million in additional revenues during each year of the 20-year period. Federal-aid funds are assured by the 1956 Act to finance 91.4 percent of the improvement costs for the Interstate System over the next 13 years. In addition, it is reasonable to assume continuation of Federal-aid funds, at least at levels now authorized for the 1959 fiscal year, for use on the Federal-aid Primary and Federal-aid Secondary Systems. Montana's apportionment, when made, from the 1959 fiscal year authorization will be approximately $14 million. This amount is over and above Federal funds for Interstate System improvements. Forest Highway funds apportioned to Montana for the 1957 fiscal year total $2.4 million. This is approximately equal to the net amount raised by one cent of gas tax. Traditionally in Montana, most of prior years' Forest Highway funds have been spent for development of State Highways. Possible increases in local support would provide additional funds particularly for local roads and local street systems.

The fiscal study will evaluate more precisely the effect and amount of future revenue from each of these sources, determine the need for tax revision and the proper distribution of revenues necessary to accomplish the long range needs on each road and street system.

AVERAGE ANNUAL COSTS 20-YEAR CATCHUP PROGRAM



STATE FINANCIAL DISTRICTS

State financial districts were created by the legislature in 1927 for the purpose of apportioning highway construction funds. State matching money is apportioned to the Federal-aid Primary System on the basis of "incomplete mileage" on that system in each of the 12 financial districts, and to the Federal-aid Secondary System on the basis of land area, rural population, rural road mileage, and value of rural lands.

As shown by the table on the opposite page, the 20-year construction needs on the proposed State Highway System in each financial district, expressed as percentage of total statewide needs, differ materially, except for district 1, from the 1956 fiscal year apportionment of state construction funds to the Federal-aid Primary System. This is partly due to the fact that the "incomplete mileage" formula does not reflect construction cost differentials caused by terrain and physical barriers such as major rivers nor does it take into consideration need for divided four-lane mileage. The differences are also due in some measure to the much higher construction standards called for under Federal policy on the Interstate System and the fact that three of the 12 financial districts have no mileage of Interstate

Financial District	Percent of Total 20-Year Construction Needs Proposed State Highway System	1956 Fiscal Year Distribution State Construction Funds To Federal-aid Primary System (Percent)
1	8.0	8.00
2	4.5	6.33
3	5.0	9.45
4	7.2	11.25
5	3.6	6.57
6	9.0	7.68
7	8.0	6.04
8	16.5	11.24
9	8.1	7.23
10	8.9	9.39
11	14.3	7.95
12	6.9	8.87

System routes. Over 75 percent of Interstate System construction costs are concentrated in only five financial districts.

Because the finance plan for the Interstate System is fixed by the 1956 Federal-aid Highway Act, it appears that modification of the Montana Financial District law will be necessary during the next legislative session in order to permit orderly and equitable development of the Federal-aid Primary System on a statewide basis. The construction needs as developed by this study afford a basis for this modification. When sufficient funds are made available, apportionment can be based logically on relative needs as expressed in dollars.

CONCLUSIONS

This engineering study provides, for the first time, information on the actual and relative needs on each class of roads and streets in Montana. The various alternative programs developed by the staff provide a sound base for an equitable fiscal plan related to long range needs.

The state's economy is closely tied to highway transportation and dependence on motor vehicles is increasing. The backlog of needs on the major road and street systems is great. There is necessity for accelerating programs to the maximum found feasible by the fiscal study. From a physical standpoint, however, a 10-year period appears to be the shortest period of time in which it would be practical to overcome the existing backlog because of the sheer volume of construction involved.

To provide a basis for efficient management, Montana's highways, roads and streets should be classified in accordance with the plan recommended in Chapter 2. Some additions are needed for a coordinated State Highway System. The major need, however, is for grouping of county roads into Secondary Road and local road systems and of municipal streets into arterial and local street systems. The classification plan developed for this study provides a simple comprehensive readjustment of responsibility permitting well defined and coordinated management. To be effective, it must be firmly related to an equitable finance plan.

Improvements in highway administration, organization and management will be needed to efficiently meet the enlarged responsibilities in the years ahead. In particular, there is need for legislative clarification and definition of jurisdictional responsibility for roads and streets within and between the various levels of governments. Improvement in intergovernmental relations and statewide coordination of highway practices and policies will result in continued improvement in highway administration.

The engineering facts reported here, coupled with the recommendations of the separate fiscal study, provide an adequate base for legislative and administrative actions necessary to implement long range construction programs. With periodic reappraisal of needs to meet changing conditions steady progress can be made in MOVING AHEAD ON MONTANA'S HIGHWAYS.

Appendix

MONTANA FACT FINDING COMMITTEE
ON
HIGHWAYS, STREETS AND BRIDGES
AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Table I

DESIGN STANDARDS FOR ARTERIAL STREETS

Design Feature	All Cities			Cities Over 5000 Population						Other Urban 5000 Population					
	(1) Controlled Access			Arterials						Arterials					
				Downtown Area		Intermediate Area		Outlying Area		Downtown Area		Intermediate Area		Outlying Area	
1976 Design Hour Traffic Volume Total For Number of Lanes Shown	7200 to 9000	Up to 6000	(2) State Highway By-Passing Only Under 750	See Below											
Surface Type	High			High		(3) High or Intermediate		High		(3) High Intermediate or Low					
(4) Number of Lanes	6	4	2	(5) Controlled By Anticipated 1976 Traffic Volumes and Operating Conditions. Determine Required Street Width By Consulting Hourly Capacity Tables											
Surface Width	72'	48'	24'												
Curbs and Sidewalks	Not Required - Pedestrians Not Permitted Pedestrian Crossings To Be Provided Where Needed			Yes		Yes		Only As Required		Yes		Yes		Only As Required	
Shoulder Width	12'		10'	Continuous		At Intersections		Continuous		At Intersections					
Median Width	Minimum 4' If Not Mountable Otherwise 20'		———	20' Median Desirable Where Design Hour Traffic Volume Exceeds 750											
Parking	Not Permitted Except On Frontage Roads			For Streets having A Design Hour Traffic Volume Exceeding 750 Parking Generally To Be Discouraged With Parallel Parking Permitted Only During Off Peak Hours. Parallel Parking Prohibited For Lower Traffic Volumes											
Illumination	Continuous		Intersections	Continuous		At Intersections		Continuous		At Intersections					
Intersection Treatment, 10% or More of Traffic on Intersecting Street	Full Access Control		(6)	Progressive Traffic Signal System or Fixed Time Signal Where Warranted, Stop Sign Control For Lower Traffic Volumes											
Less Than 10% of Traffic on Intersecting Street			(7)	Traffic or Pedestrian Actuated Signals Where Warranted or Stop Sign Control											
Structure Width	(8) Under 100' Long - Full Roadway Width Over 100' Long - Pavement Width Plus 2' Offset From Barrier Curb			Pavement Plus Sidewalks											
Vertical Clearance	16'			14.5'											
Loading	H 20 - S 16			(9) For Heavy Commercial Traffic H 20 - S 16 Other H 20											
Railroad Crossing Separation	At All Railroad Crossings			Main Line Crossings On Streets Carrying Heavy Traffic Volume Where Practical and Economically Feasible											
Railroad Grade Crossing Protection	———			Flashing Light Signals At All Crossings Without Watchman or Flagman and Where Average Daily Traffic is Number of Trains - 2000 or More											

(1) Standards for Controlled Access Arterials Based on a 40 MPH Operating Speed. Access Permitted Only At Intersections and Intersections Will Offer Arterials Access From Abutting Property By Frontage Streets Where Required
(2) Applies Specifically To New Location of 2 Lane State Highway Routes By Passing Business Areas of Municipalities
(3) Geometric and Amount of Traffic Should Determine The Type of Surface Required
(4) 12 Feet Traffic Lanes
(5) Street Width Design Should Be Distinctly Less Than Numbers of 11' or 12' Lanes Except Where One-Way Operation Is Planned
(6) Grade Separation Where Warranted and Feasible, Otherwise Channelized and Signalized Intersection At Grade
(7) Channelized and Signalized Intersections At Grade
(8) Including Structure at Approaches
(9) Heavy Commercial Traffic Includes Large Numbers of Trailer Trailers

MONTANA FACT FINDING COMMITTEE
ON
HIGHWAYS, STREETS AND BRIDGES
AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Table II

DESIGN STANDARDS FOR RURAL STATE HIGHWAYS

| | Multi-Lane | | | | | | | | | | | |

MONTANA FACT FINDING COMMITTEE

ON

HIGHWAYS, STREETS AND BRIDGES

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

DESIGN STANDARDS FOR COUNTY LOCAL ROADS

	Service Characteristics	Design Code	Surface Type	Surface Width	Roadway Width
	Subdivision Streets (Rural)				
a	Medium developed, grid type pattern	20	Intermediate	30'	30
b	Sparse development, no regular pattern	40	Stabilized Surface	20	30
c	Rural Mail Route				
a	Heavy traffic generated by industry, business, etc.	30	Heavy Gravel	22'	28
b	Light traffic generated by residences	40	Medium Gravel	20'	26
d	Summer Maintenance Only				
a	Mountainous terrain	50	Light Gravel	18	18
b	Plateau areas	50	Light Gravel	20	20
e	Trails Not Regularly Maintained		To Be Brought Up By Maintenance		

a Curbs and Gutter Section - Storm Drains Laterals As Required

b 4" to 6" Depth

c 1 to 4 Depth

d Less Than 1" Depth - Spot Treatments Only - Grade Where Not to Safe Move Sand Supporting Subbase

MONTANA FACT FINDING COMMITTEE

ON

HIGHWAYS, STREETS, AND BRIDGES

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Table II

TOLERABLE CONDITIONS FOR RURAL STATE HIGHWAYS

(NOT APPLICABLE TO INTERSTATE SYSTEM ROUTES?)

1955 ADT (Total)		Over 2000 (1)			1000-2000			400-1000			200-400			Less than 200		
Terrain Class		Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn
Surface Type — Good Condition		Type 2 — Intermediate						Type 3 - Low						Type 4 - Gravel		
Surface Width - Feet		20									18			—		
Roadway Width — Feet		28		26	28		24	24			24			24		
Average Design Speed - MPH		60	50	45	60	50	45	50	45	40	50	45	40	50	40	35
Maximum Curvature - Degree		5	7	9	6	9	12	9	12	14	9	12	14	9	14	20
(2) Maximum Gradient - Percent		5	5	7	5	7	7	6	7	8	6	7	8	6	8	10
Bridge	Loading	H-20						H-15						H-10		
	Width — Feet	2 Feet Wider Than Approach Surface Width. Minimum 22 Feet									Approach Surface Width Minimum 20 Feet					
	Vertical Clearance - Feet	14												13.5		

(1) For Roads Carrying Traffic in Excess of 2,000 VPD Capacity Studies May Indicate Need for 4 Lanes or Truck Climbing Lanes

(2) For Grades Over 1,000 Feet in Length Subtract 1 Percent

Control of Access Not Required

In Suburban Congested Areas Design Speeds May Be Reduced 10 MPH With Appropriate Adjustment in Maximum Curvature

MONTANA FACT FINDING COMMITTEE

ON

HIGHWAYS, STREETS AND BRIDGES

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

DESIGN STANDARDS FOR MUNICIPAL LOCAL STREETS

City Size	Area	Service Characteristics	Design Code	Surface Type	Surface Width
Under 1000 Population	Close In	Developed - Grid Pattern	20	Intermediate	36
	Intermediate	Normal Grid Development	30	B.S.T.	30 a
	Out Lying	Shute - Irregular Pattern	40	Gravel	24 a
1000 To 2500 Population	Close In	Developed Grid Pattern	20	Intermediate	36
	Intermediate	Normal Grid Development	30	B.S.T.	36
	Out Lying	No Regular Pattern	40	Gravel	24 a
2500 To 5000 Population	Close In	Developed - Grid Pattern	18	High	36
	Intermediate	Normal Grid Development	20	Intermediate	36
	Out Lying	No Regular Pattern	30	B.S.T.	36
	Out Lying	Sparse Development	40	Gravel	24 a
Over 5000 Population	Industrial Business	Heavy Traffic	10	High	40
	Heavily Developed	High Density Of Population	11	High	36
	Intermediate	Normal Grid Development	20	Intermediate	36
	Out Lying	Sparse Development	30	B.S.T.	36

a Rural Type Cross-Section

MONTANA FACT FINDING COMMITTEE

ON

HIGHWAYS, STREETS, AND BRIDGES

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Table I

TOLERABLE CONDITIONS FOR SECONDARY HIGHWAYS

1955 ADT		400 - 1000 (1)			200-400			100-200			50-100			25-50			Under 25		
Terrain Class		Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn	Flat	Rolling	Mtn
Safe Driving Speed - MPH		40			40			30			30			30			25		
Surface Type (In Good Condition)		Type 3 Low Bituminous			Type 3 Low Bituminous			Type 4 Gravel			Type 4 Gravel			Type 4 Gravel			Type 5 Gradet & Dressed		
Surface Width - Feet		18			18			20			20			18			18		
Roadway Width - Feet		24		22	24		22	20			20			18			18		
Drainage		Culverts of Adequate Capacity to Prevent Roadway Flooding			Culverts of Adequate Capacity to Prevent Roadway Flooding			Longitudinal and Transverse Drainage Sufficient to Permit Vehicular Usage Except Under Very Adverse Conditions											
Snow Control		Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing																	
Bridges	Loading	H-15			H-10			H-10			10 Tons			10 Tons			10 Tons		
	Bridge Roadway Width (Feet)	Equal To Approach Surface Width - Min 18						18			18			18			1-Lane Bridge Acceptable		
	Vertical Clearance (Feet)	13.5			13.5			13.5			12.5			12.5			12.5		

(1) Use Tolerable Conditions for Rural State Highways When 1955 ADT Exceeds 1000

PROGRAM COSTS – COUNTY ROADS

(In Thousands)

County	SECONDARY ROAD SYSTEM — Average Annual Costs				LOCAL ROADS
	10-Year Period	Second 10 Years of 20-Year Period	15-Year Period	20-Year Period	Average Annual Cost for 20-Year Period
Beaverhead	$ 407	$ 206	$ 365	$ 306	$ 243
Big Horn	513	293	481	403	239
Blaine	715	321	598	518	287
Broadwater	125	59	107	92	144
Carbon	305	230	306	268	206
Carter	368	173	320	271	177
Cascade	717	323	613	520	459
Chouteau	1,103	356	853	729	585
Custer	511	165	394	338	239
Daniels	262	180	247	220	183
Dawson	535	190	434	362	261
Deer Lodge	101	54	91	77	90
Fallon	308	83	231	196	251
Fergus	716	303	596	510	437
Flathead	470	133	362	301	315
Gallatin	647	245	501	446	314
Garfield	305	128	253	216	303
Glacier	459	207	387	333	152
Golden Valley	163	61	135	111	135
Granite	117	33	92	75	87
Hill	724	267	573	495	349
Jefferson	263	89	202	175	191
Judith Basin	224	115	200	169	284
Lake	352	192	309	272	193
Lewis and Clark	593	252	501	422	363
Liberty	297	118	244	208	112
Lincoln	188	103	168	146	200
McCone	515	213	441	364	281
Madison	327	136	279	232	256
Meagher	141	83	125	112	94
Mineral	101	37	78	69	68
Missoula	318	139	272	229	366
Musselshell	212	70	167	141	204
Park	272	96	213	184	212
Petroleum	113	35	89	74	109
Phillips	655	219	508	437	340
Pondera	467	230	399	348	241
Powder River	409	203	365	306	155
Powell	239	95	183	167	171
Prairie	417	122	319	269	200

PROGRAM COSTS – MUNICIPAL STREETS

(In Thousands)

Place or Population Group	ARTERIAL STREETS — Average Annual Costs				LOCAL STREETS
	10-Year Period	Second 10 Years of 20-Year Period	15-Year Period	20-Year Period	Average Annual Cost for 20-Year Period
Billings	$ 494	$ 148	$ 378	$ 321	$ 358
Butte	212	139	205	175	519
Great Falls	313	171	270	241	474
10,000 - 25,000	548	201	432	374	669
5,000 - 9,999	338	149	280	244	479
2,500 - 4,999	25	15	21	20	569
1,000 - 2,499	66	47	65	57	500
1 - 999	194	57	150	125	321
Totals	$ 2,190	$ 927	$ 1,801	$ 1,557	$ 3,889

PROGRAM COSTS — COUNTY ROADS — (Continued)

(In Thousands)

County	SECONDARY ROAD SYSTEM — Average Annual Costs				LOCAL ROADS
	10-Year Period	Second 10 Years of 20-Year Period	15-Year Period	20-Year Period	Average Annual Cost for 20-Year Period
Ravalli	$ 502	$ 160	$ 391	$ 331	$ 179
Richland	404	127	307	265	328
Roosevelt	411	248	356	330	266
Rosebud	778	355	676	567	298
Sanders	597	195	470	396	210
Sheridan	501	229	413	362	237
Silver Bow	199	82	169	141	166
Stillwater	443	180	359	311	187
Sweet Grass	230	77	188	153	141
Teton	458	232	391	345	382
Toole	411	173	335	293	228
Treasure	213	106	191	160	63
Valley	743	305	596	522	344
Wheatland	119	50	102	85	126
Wibaux	238	72	183	156	143
Yellowstone	867	270	684	569	572
Totals	$22,788	$ 9,418	$18,812	$16,097	$13,366

20-YEAR CONSTRUCTION COSTS

IDENTIFIED NEEDS

(In Thousands)

National System of Interstate and Defense Highways

	Rural	Urban	Total
Right of Way	$ 23,320	$ 1,728	$ 25,048
Grade and Drain	58,270	1,378	59,648
Base and Surface	94,522	1,268	95,790
Structures	85,142	6,060	91,202
Total	$261,254	$ 10,434	$271,688

Proposed State Highway System

	Rural	Urban	Total
Right of Way	$ 31,208	$ 2,826	$ 34,034
Grade and Drain	143,679	5,556	149,235
Base and Surface	230,667	8,773	239,440
Structures	177,363	17,247	194,610
Total	$582,917	$ 34,402	$617,319

Federal-aid Primary System

Right of Way	$ 7,613	$ 477	$ 8,090
Grade and Drain	83,953	3,513	87,466
Base and Surface	132,796	6,597	139,393
Structures	87,504	9,821	97,325
Total	$311,866	$ 20,408	$332,274

Proposed Secondary Road System

Right of Way	$ 6,690
Grade and Drain	72,703
Base and Surface	93,109
Structures	32,991
Total	$205,493

Federal-aid Secondary System

Right of Way	$ 2,305	$ 17	$ 2,322
Grade and Drain	24,753	924	25,677
Base and Surface	41,699	1,300	42,999
Structures	16,875	876	17,751
Total	$ 85,632	$ 3,117	$ 88,749

Proposed Arterial Street System

Right of Way	$ 55
Grade and Drain	4,751
Base and Surface	7,733
Structures	3,966
Total	$ 16,505

Class 1 Forest Highways

	On Interstate Routes	On Other Federal-aid Primary Routes	Total
Right of Way	$ 1,085	$ 979	$ 2,064
Grade and Drain	5,701	21,624	27,325
Base and Surface	4,412	16,124	20,536
Structures	11,310	8,661	19,971
Total	$22,508	$47,388	$69,896

Class 2 & 3 Forest Highways (Partial)

Right of Way	$ 11
Grade and Drain	854
Base and Surface	1,219
Structures	958
Total	$3,042